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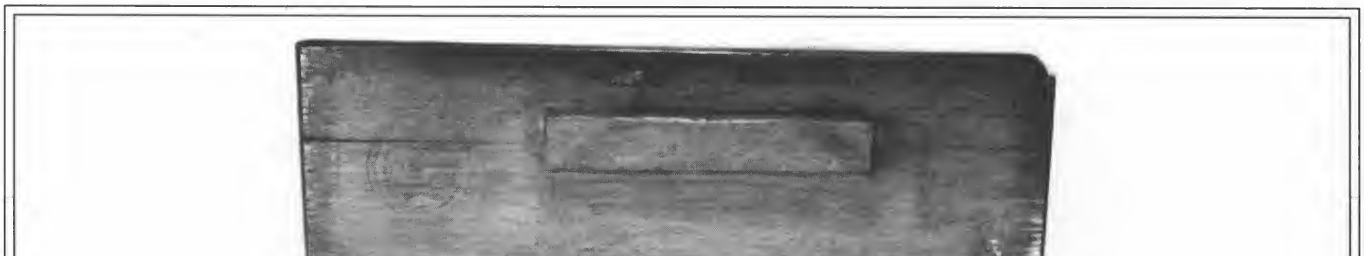

Cover Picture

This anonymous steel beam is one of the many small puzzles that faces collectors. The oak box is 11¾ x 7¼ x 2½ inches (300 x 187 x 60 mm) with a sturdy lock on the front. The swan-neck beam is thick round-section steel, built for what would later be called Class 2 weighing (ie. not for extreme accuracy). A leather tab is sewn to the ring at the top of the shears so that the user had a good grip on a relatively heavy load. The cords are very thick, but bound nicely with genuine gold thread. The round pan, 5¾ ins (145 mm) across, is of very heavy-gauge brass hand-beaten, and the square pan is similarly sturdily-made of thick brass with rolled edges hammered flat to allow the bending up of two sides. For a box that otherwise looks entirely 18th century, the brass is surprisingly yellow and free of imperfections, more 19th than 18th century. The fittings in the box give some clues. The block (at bottom left) precisely takes nesting weights for 16 oz down to ½ oz Avoir, and the bruises on the lid match that supposition. At the left, a small felt-lined cavity is just visible, the lid missing, but it originally held grain weights. To the rear of the nesting set is a deep cavity 3¼ x 2½ x 2 ins. deep, lined with green hessian, and to the rear of the grain weight locker is a smaller deep cavity 4 x 1¼ x 2 ins. deep, with hessian worn away by something stored vertically against the side of the box. These two cavities are notionally linked by a slot cut across the dividers, as if a pillar went across and a base was somehow stored in a well, to be attached when required, but the wells are too small to take a base of usable diameter. At some time in its working life the lid was bruised by a second set of nesting weights for 16 oz. (1¼ lb.) Troy, which exactly fits the bruises. What was it for? Why a square pan? What went in the cavities?

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Remarkable Moneyweight Scale BY B F SMITH

While my wife Mary and I were shopping in a small antique mall in Mason, Michigan, we happened upon their "junk barn" which was unattended, unheated, draughty, and damp because of a leaky roof. Even so, we stopped to browse. At the time I was a beginner who knew very little about scales. An unusual scale with some puzzling weights caught our attention. Even though the scale was very dirty, it appeared to be in good working condition. We enquired at a shop across the street as to its ownership and price, both of which were unknown. After roughly two weeks of persistently ‘phoning persons in the mall, we obtained answers to both questions and attempted to contact the owner. A week or two later we claimed our prize and took it home to examine it more thoroughly.

This is clearly the largest, most complex, and most impressive counter scale I had ever seen. Overall, it measures 22” deep by 25” wide by 27” high [550 x 620 x 670 mm]. In addition to the usual platform mechanism for weighing, it has a towering superstructure with several beams for indicating the price. Name plates on both the front and the back of the upper assembly identify the maker as the Computing Scale Co., Dayton Ohio, with the additional information, “The Moneyweight Scale” on the back. Something told me that this scale had played an important role in American marketing.

Fig. 1. Computing Scale Co. c.1895. The beams are graduated on both sides so that the customer and the store-keeper can read them. Photo B Smith

My scale was produced under patents dating from 1888 through 1894, which impressed me as being rather early for a price-indicating platform scale.[1] This piqued my curiosity and I resolved to learn the stories behind these scales and their makers. But first, I had to figure out how they worked. Fortunately, I discovered that the scale had the original marble goods plate with the guarantee and testing instructions on the back (see fig. 2). This was extremely useful information since it provided the clues necessary to figure out how to use the scale, which in turn enabled me to furnish the information to other ISASC members at the New Orleans convention in 1996.

Operation of the Moneyweight scale

In order to easily understand the complex operation of this scale, I believe it is necessary to think of it as consisting of a lower body assembly (essentially a platform scale for measuring weight) and a moveable upper carriage assembly used for measuring value. The components are linked together by a connecting rod with proper connections for the weighing beam below the supplemental base. They terminate in a yoke embracing the computing beams and having bearings for the reception of the knife edges, which are rigidly mounted on a connecting block sliding on the beams and adapted to indicate the price per pound by registering with proper indices on the lower beam. The connection is loose and works with perfect freedom, ensuring the greatest accuracy in the weighing operations.

GUARANTEE

No.......... Dayton, Ohio..........

The Computing Scale hereby guarantees this scale shall, if properly used, indicate the correct value of any article capable of being weighed upon it, and within its capacity as given below, at any given price from 3c to 60c per pound.

Capacity for weighing 100 pounds.

Capacity for computing from 3 to 15 cents per pound, $9.00.

Capacity for computing from 16 to 60 cents per pound, $36.00.

Should this scale get out of order at any time within two years from date of shipment, with ordinary use, The Computing Scale Company agree to repair the same gratis, the purchaser paying the transportation to and from the factory.

THE COMPUTING SCALE COMPANY
/s/ O O Ozias, General Manager

Directions for balancing the Scale when Out of Balance,- Ordinarily, when scale is out of balance, it may be adjusted by turning 'balance ball' until you have the required balance, but, if the scale is out of balance on account of loss of paint or accumulation of any kind on the beams and cannot be balanced in regular manner, proceed as follows: Set scale on 3, and either put in or take out shot in upper counterpoise until you have a balance, then move the carriage and set on 60, and remove or put in shot in the lower counterpoise until you have a balance, then go back to 3, and then back to 60 and continue back and forth a few times and you will have a perfect balance of the scale under any condition.

CAUTION,- Do not change shot until you have followed the instructions on direction sheet sent with scale.

Fig. 2. The guarantee stuck to the bottom of the goods plate.

Although apparently subdivided into five "beams", this scale actually consists of two beams (with three sub-beams). By concentrating on the lines of three bearings that in each case rock one casting, the multiple beams become obvious.

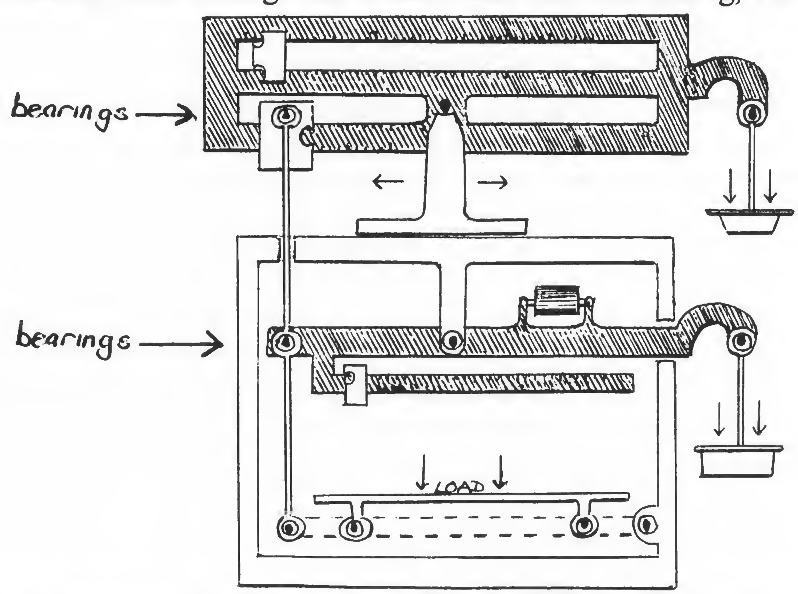


Fig. 3. >> Diagram indicating the bearings that operate the top casting of three beams (to indicate price) and the lower casting of two beams (to indicate weight). Drawing A J Crawforth

The Weights

I believe the name *Moneyweight Scale* is derived from the design of the loose poises that are essential to its use. Each poise has three figures as follows;-

40 lbs - $16 - $4 20 lbs - $8 - $2 10 lbs - $4 - $1 5 lbs - $2 - $0.50

used to indicate either money or weight. There were originally three of the largest poise design.

Fig. 4. Four of the original six loose-poises. Possibly a matching tare-poise came with the container. Photo B Smith

The Lower Assembly

The lower assembly is for the weighing process. The lower beam is split into a c-shape, designated lower beam **A** and lower beam **B**. The whole of the lower beam is suspended from the frame on a fulcrum one third of the way along lower beam **B**. A balance-ball (cylinder) is screwed along a rod attached to lower beam **B**, to correct any tiny misalignment of the beam in relation to the levers under the platform. The hanger for the loose poises is suspended from the end of lower beam **B**. The early patents refer to this section of the scale as *an ordinary grocers' platform scale.*

The lower beam **A** is made of brass and is bolted to lower beam **B**. The rider poise is clearly labelled *for tare only*. If a container was used when valuing a product, the grocer put the empty container on the platform and moved the rider poise along lower beam **A** until the lower beam was back in equilibrium. (Thus the rider poise was acting as a tare-poise.) Then the grocer put the product into the container and moved the upper carriage until the price poise indicated the price per pound, adding the loose poises to the value on upper beam **D** or **E** as specified.

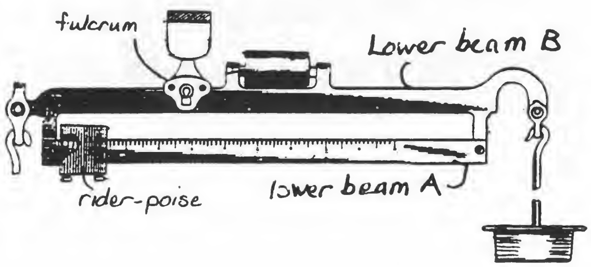


Fig. 5. << The lower beam, hanging from the stand. If the load was over 10 lbs, loose-poises were put onto the hanger on the right, adding up to slightly *under* the total weight. The rider-poise was slipped along until the beam was balanced, and the amount on the loose-poises was added to the amount shown on the rider-poise.

Taken from British patent no. 9841, 29th April 1898.

The mixing of the words "tare" and "weighing" causes confusion. When weighing, the word tare was appropriate because the taring of the container was being done the hard way, i.e. the container (referred to as the scoop in all the patents) was put on the platform, the rider poise was moved along lower beam **A**, and the weight of it noted on a piece of paper. Then the product was put into the container and the two were weighed together, using loose poises on the hanger if the two weighed more than 10 lbs. The weight of the container was then subtracted from the whole, and the customer was told the weight of the product.

A grocer could probably buy a container (scoop) from the Computing Scale Co, with its matching tare poise; then subtraction would be unnecessary. The grocer would just slip the tare poise onto the hanger when putting the container or scoop on the platform and the weight of the container would not be taken into account.

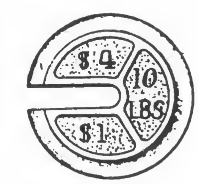


Fig. 6. ^ ^ Loose-poise, $4 in red, $1 in white. Colour-coding started in 1894.

The Upper Carriage Assembly

The upper carriage assembly consists of the upper beam (sub-divided into three beams), the loose-poise hanger at the right end, a counterbalancing block at the left end, the central fulcrum upon which the entire upper carriage rests, and the mechanism for moving and locking the carriage. The beams are actuated by the rod at the left, (in fig. 7), which is connected to the lever assembly under the platform, then to lower beams **A** and **B** and finally to the price poise on beam **C**. The assembly is locked into a fixed position by means of a notched bar attached to the handle at the left and a corresponding V-shaped piece attached to the inside of the frame. Pulling the handle forward disengages the lock and by means of a cam raises the assemble approximately ¼ inch. This also lifts the brake on the right side until beam **C** rests upon it, thus locking the beams while moving the carriage. The carriage then moves freely on wheels to the desired position. This is more fully detailed in patent No. 506793 dated October 17, 1893. By 1894 the company was colour-coding this beam and the loose poises to reduce mistakes.

Fig. 7. ➤➤
Beam

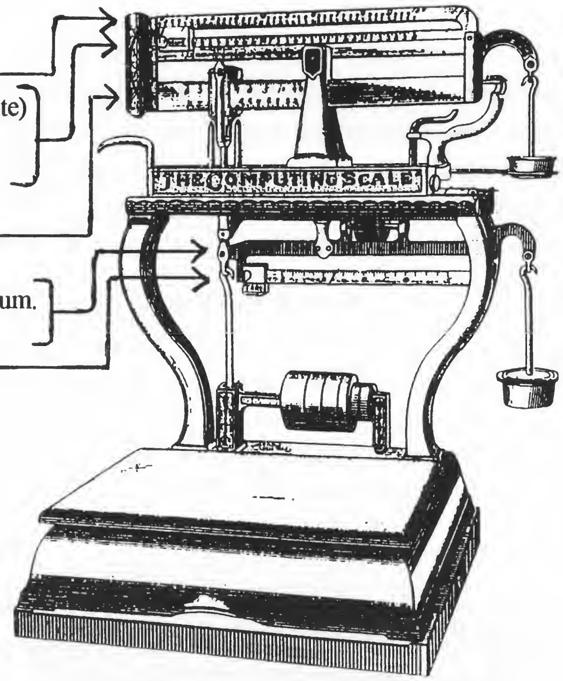
E Shows value when price per lb is 16c or more. (Red)

D Upper half shows value when price per lb is 15c or less. (White)
Lower half shows lbs & oz when price poise is at 10c
Has the hanger for the loose-poises

C Shows price per pound;-
Upper half 16c to 60c- right to left. (Red)
Lower half 3c to 15c- right to left. (White)

B Cast as one with beam A. Carries Balance-ball. Has the fulcrum.
Has the hanger for the loose-poises

A For Tare or for weighing. Calibrated 0 to 10 lbs.



MONEYWEIGHT SCALE
Manufactured by
COMPUTING SCALE COMPANY
DAYTON, OHIO, USA

Serial No. 56688
Patented June 26, 1888
November 22, 1892
October 9, 1894

If no container or scoop was needed the upper beam could be used alone. The product on the platform pulled the rod on the left down. Then the price poise was brought into action by moving the upper carriage through the poise (leaving the poise and the rod in the same place) until the price poise indicated the price per pound of the product. If the product was priced between 3c and 15c per pound the lower (white) numbers were looked at. If the price was between 16c and 60c the upper (red) numbers were looked at. The grocer added loose poises to the hanger to just below the total value of the goods and used the rider poise between beams **D** and **E** to bring the scale into equilibrium.[2] Then the appropriate number, depending on the price, was taken from beam **D** or **E** and added to higher or lower price on the loose poise to determine the total cost of the product.

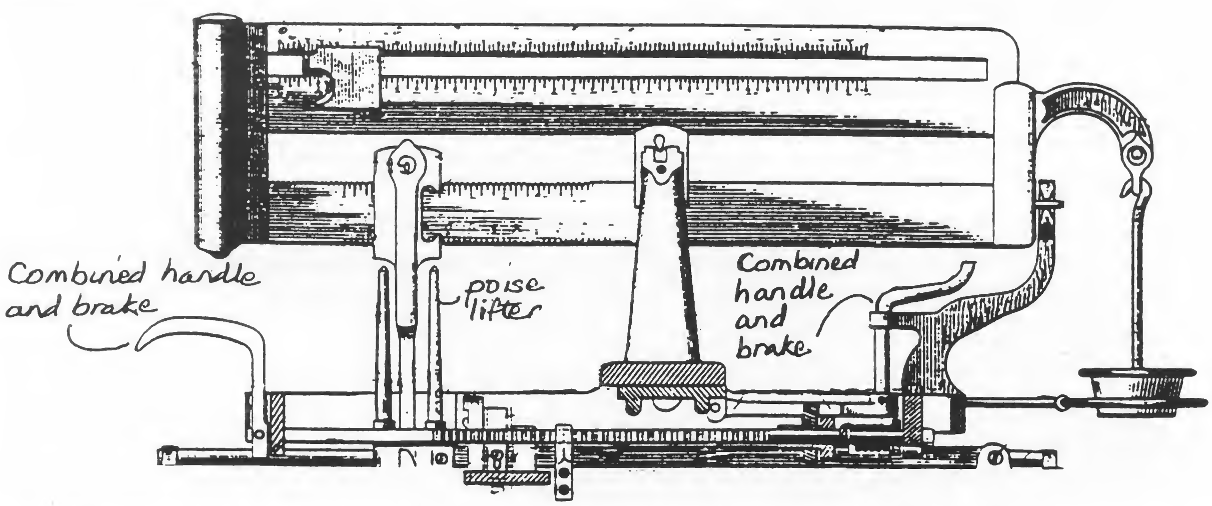


Fig. 8. The carriage that sat on the frame, and moved sideways through the price-poise. The number of parts needed to move, brake and co-ordinate the parts was upward of 17 little machined bits, all drawn in fine detail for the patent of 1898. This must have been an expensive scale to manufacture.

Set amounts

The scale could be used two other ways. If the customer required a set weight of a product (for example, 13 lbs), the lower beam was used. The loose poises were put on to just *below* the weight specified (see Fig. 15 for the addition of an indicator to alert the user to this) and the rider poise on lower beam was moved to indicate, when added to the weight marked on the loose poise, exactly what was requested. Then the product was put onto the platform until the beam balanced. The rider poise was moved back to zero (so it wouldn't act as a tare poise) and the upper carriage moved until upper beam **C** indicated the price per pound (for example, 14c), and used the loose poises and beam **D** to get the value - $1.82.

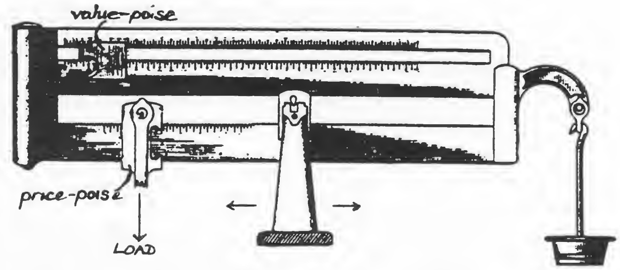


Fig. 9. As can be seen in the photograph below, the whole of this upper carriage is moved by the left-hand handle (not shown), thus positioning the price-poise where needed. This operation puts this triple beam out of equilibrium, and the loose poises and the value-poise must be added until the triple beam returns to equilibrium.

Conversely, if the customer wanted $2.00 worth of product, the grocer moved the carriage until the price poise indicated the sale price of the product and then used a loose poise with a $2.00 value, either high or low depending on the price with the rider poise set at zero. Then the product was put onto the platform until the upper beam was in equilibrium.

If a container was needed, the taring was done at the beginning of the process, using the tare rider poise on lower beam **A** if a total worth had been established; or using the tare-loose poise or the subtraction method, if a total weight had been established.

Fig. 10. Large iron weights put on the platform to imitate a product being valued at 24 cents per pound. The beams are graduated on both sides so that the customer and the grocer can read them. Photo B Smith

The scale has the capacity to weigh 100 pounds and to compute values to a maximum of $9.00 on beam **D** and a maximum of $36.00 on beam **E**. Note that these relate to a maximum of 60 pounds.

Practical example

To use this scale to compute value without a container or scoop, for example, 24lb @ $0.30 / lb.:-

1. Set rider poise of lower beam at 0 and make sure that there are no loose poises on either hanger.

2. Set price poise on upper beam **C** at 30. This is accomplished by the method previously described.

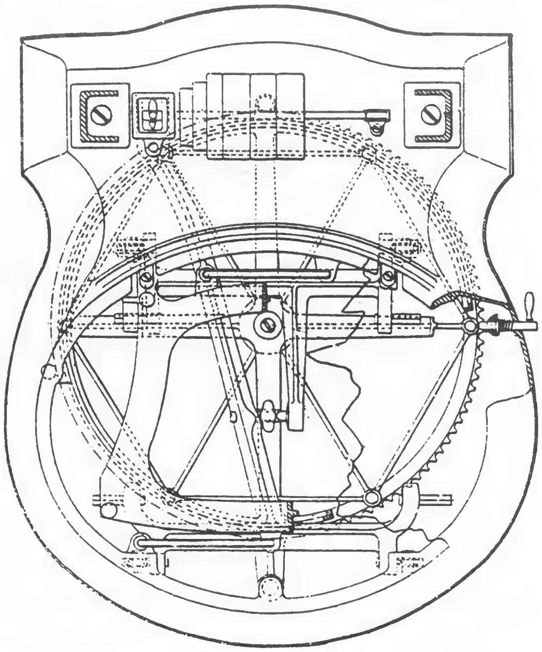
3. Put the product being valued on the platform.

4. Add loose poises and move rider poise between beams **D** and **E** to achieve equilibrium, which will occur when the rider poise reads 120 on beam **E**. The loose poises used will be the ones with the high value readings of $4 and $2. These, added to the 120 on beam **E,** will equal $7.20, or the value of 24 lbs. at $0.30/lb.

5. Note that the scale will not balance using the 20 lbs loose poise since the high value on that weight is $8 which is over the value of the product. However, the 20 lbs weight can be used to *weigh* the product.

Fig. 11. ⋞⋞ R Willard's example demonstrates the evolution of Ozias' ideas. Although this version has the patent date of 12.20.1898, none of the changes visible actually relates to that patent. All the improvements in the patent relate to 12 hidden items, 5 stop-rests, 5 rollers, and a lock. Photo R Willard

Fig. 12. ⋎⋎ British patent no. 5264.

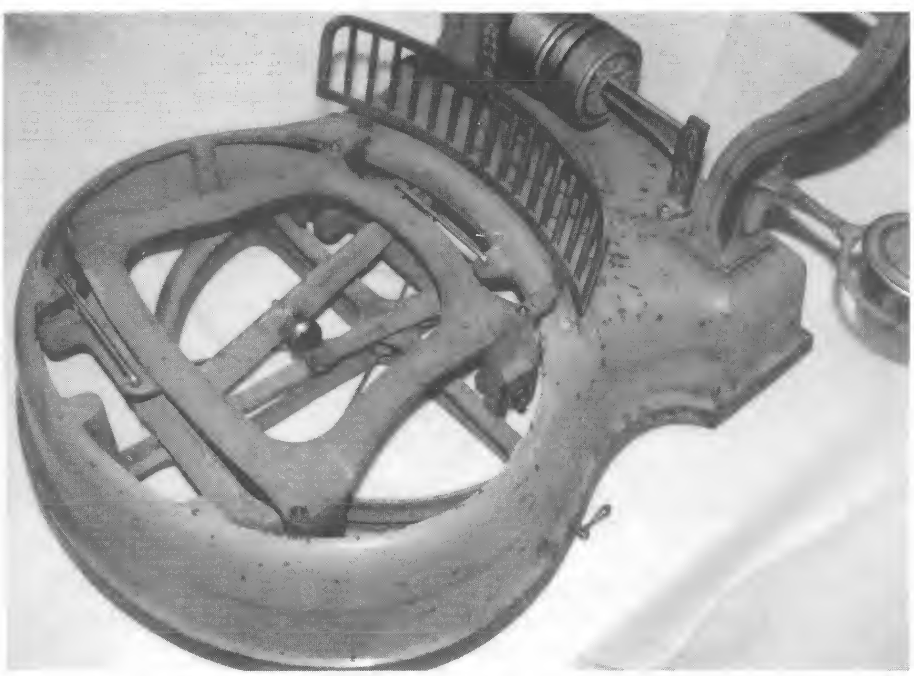


Moneyweight Scales in ISASC Collections

There are at least three other Moneyweight scales in ISASC collections. I obtained my second one through a friend who saw it "as is" in a room at an antique mall in Tecumseh, MI. After extensive repair it is now in working order. Judging by the patents, it is about a year older than my first one. For another example see the scale owned by the late Todd Carley, EQM 216-217.

Fig. 13. ⋟⋟ The base of the scale above. The oval plate was an advantage when using plate-glass because there were no corners on the glass to be easily damaged.

The circle visible at the bottom of the interior was first manufactured in 1898, as evidenced by the British patent no 9841, applied for on 29th April 1898. See above. It was a swivel base which permitted rotation of the whole superstructure, but which could be locked by turning the little handle seen at the lower front.
Photo R Willard



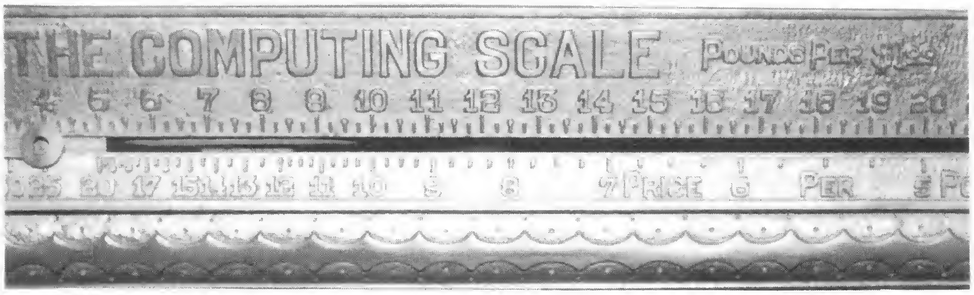


Fig. 14. ≪ Yet another little refinement:- a conversion table. The upper line gives Pounds per $1.00, and the lower line converts that to Price per pound. As shown by the little ring, 25 cents per pound is the same as 4 pounds for $1.00.

Inventors, Makers, and Marketers

While the Moneyweight Scale under that name was made and marketed by the Computing Scale Co. of Dayton, it had its origins elsewhere. One Julius E Pitrat[3] of Gallipolis, Ohio, originated a simple lever type of scale which had attached thereto an auxiliary computing device and obtained patents on this idea in 1885, 1886, 1887, and 1888. These patents were sold in 1888 to R E Hull. Late in 1889 Orange O Ozias and Edward Canby, both of Dayton, Ohio, bought the patents from R E Hull.[4]

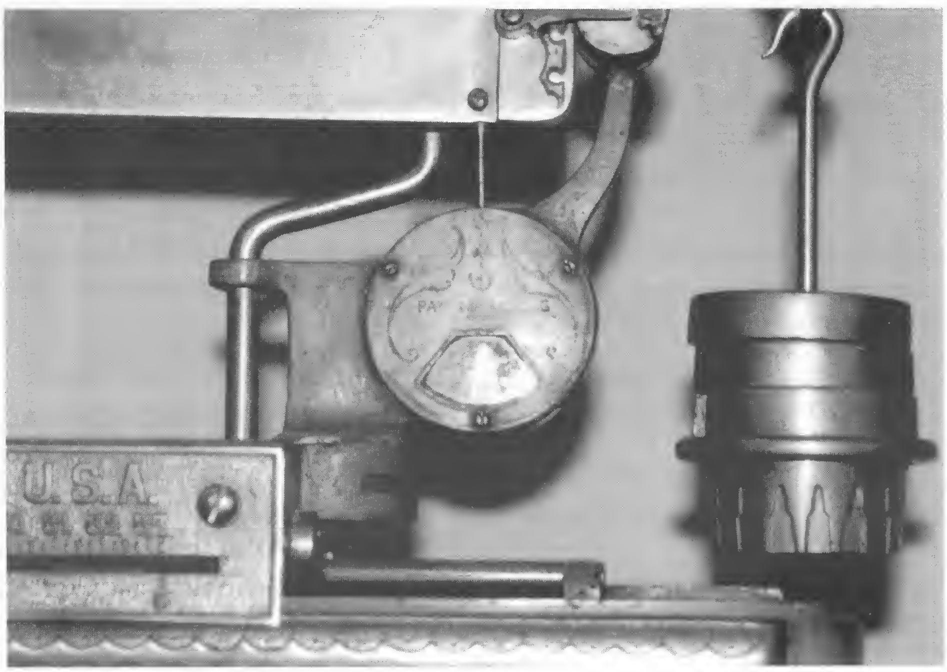


Fig. 15. ≫ The circular device in the centre of the photo is for indicating when the load has nearly reached the required amount. It consists of two vanes pivoted inside a drum-shaped casing and has curved projections normally acted on by the end of the rod descending into the casing. A slight motion of the beam releases the vanes, which come together to expose a coloured background. This device was patented in Britain in 1901, but the casing is labelled Patent Pending, so dating this scale to 1900-1901. Photo R Willard

Around March 30, 1891, Ozias and Canby organised the Computing Scale Company. They also purchased the A U Smith patents, which were, to a certain extent, forerunners of the drum-type computing scale. In 1891 William H Sanderson of Dayton assigned rights to his patent for a weighing and price scale to them. They probably bought the 1892 patent of John Woodruff Culmer, a draftsman of New Brighton, PA (and later a consulting mechanical engineer of Beaver Falls, PA), since there is no

Fig. 16.

B Smith's not photographed	Tod Carley's not photographed	B Smith's photographed	R Willard's photographed
Patent date 3.31.1886	Patent date 3.31.1886	Patent date 6.26.1888	Patent date 12.20.1898
Patent date 1.11.1887	Patent date 1.11.1887	Patent date 11.22.1892	
Patent date 6.26.1888	Patent date 6.26.1888	Patent date 10.9.1894	
Patent date 4.28.1891	Patent date 4.28.1891		
Patent date 11.22.1892	Patent date 11.22.1892, 486663		
Patent date 10.17.1893	Patent date 11.22.1892, 486695		
	Patent date 10.17.1893		

record of his being connected with the company. Orange Ozias himself became a prolific inventor, patenting numerous computing scales that employed various mechanical principles. Albert N Ozias, of Racine, Wisconsin, and subsequently of Minneapolis, Minnesota, also contributed delightfully original designs to the Computing Scale Co. in 1899 and 1900, but the patent papers do not specify the relationship between the two Ozias.

Fig. 17.

American Patents pertaining to the Moneyweigh Scale			
Date	Patent No.	Description	Patentee
3.31.1885	314,717	Weighing and Price Scale	Julius E Pitrat, Gallipolis, OH
5.4.1886	341,166	Price Scale	Julius E Pitrat, Gallipolis, OH
1.11.1887	356,077	Weighing and Price Scale	Julius E Pitrat, Gallipolis, OH
6.26.1888	385,005	Weighing and Price Scale	Julius E Pitrat, Gallipolis, OH
4.28.1891	451,075	Weighing and Price Scale	William H Sanderson & Orange O Ozias,* Dayton, OH; said Ozias assignor to himself and Canby, Dayton, OH
11.22.1892	486,663	Computing Scale	John Woodruff Culmer, New Brighton, PA
11.22.1892	486,695	?	?
10.17.1893	506,793	Price Scale	Orange O Ozias, Dayton, OH
10.9.1894	527,124	Price and Weighing Scale	Orange O Ozias, Dayton, OH**
12.20.1898	616,348	Price and Weighing Scale	Orange O Ozias, Dayton, OH

* Documentation states that this patent should have been issued in the names of Orange O Ozias and Edward Canby, Dayton, OH, as sole owners of the invention, said Ozias and Canby being assignees of the entire interest of said Sanderson.

** The author's Computing Scale has the patent of 1894 listed, but, on studying the patent papers, several design-features differ from that patent. However, the patent papers of 1898 match the design of his scale. Could his scale have been produced while the 1898 patent was pending?

Business was excellent right from the start. By 1904 the company employed hundreds of men in its factory and had 300 men selling their products in both hemispheres, including South Africa and South America as well as the islands of Australasia.[5] The innovative Moneyweight Scale became the best known of its type in Britain, but was no longer stamped for use in trade there after the imposition of the Weights and Measures Act of 1904.[6]

In 1893, arrangements were made for Samuel Hastings and Walter Mills to operate as a general sales agency for the Computing Scale Co. On March 1, 1899, the Moneyweight Scale Co. was organised as the selling organisation of the Computing Scale Co. in the US and Canada.[7] The name was later changed to Dayton Moneyweight Scale Co. The Stimpson Computing Scale Co, which had been organised in 1896, was included in the consolidation. On Oct. 23, 1901, the Computing Scale Co. was re-incorporated and the name changed to Dayton Automatic Scale Co.

Further consolidations followed. On June 6, 1911, the Computing-Tabulating-Recording Co. was formed as a holding company controlling four business-machine manufacturers: the Computing Scale Co, the Bundy Manufacturing Co. and the International Time Recording Co. (both makers of time clocks), and the Tabulating Machine Co., with the scale companies comprising the Dayton Scale Co. Division. In 1917 that division took over the American Automatic Scale Co. of Chicago and changed its name to the International Scale Company.

Thomas J Watson, the most famous person associated with the Moneyweight Scale, became president of the Computing-Tabulating-Recording Co. in 1913. He is first listed in the 1922 Dayton, Ohio, directory as chairman of the board of directors of the Dayton Scale Company. In 1924, the Computing-Tabulating-Recording Co. changed its name to International Business Machines.[8]

MONEYWEIGHT SCALE CO.

47 STATE STREET

CHICAGO, 3/27/02

Tinsley and Hanson
Pony, Mont.

Dear Sir :

Upon receipt of Scales kindly sign the enclosed notes, attach revenue stamps to same and return to us.

Our object in securing notes is to facilitate the work in our office, as we have thousands of accounts on our books, and having notes expedites the business, as we can then close the account on the books. These notes do not draw interest.

If you wish to discount the account we will allow you 10 *% off for cash in* 30 *days.*

Yours truly,

MONEYWEIGHT SCALE CO.

Mont-41. Per L. D. H.

Fig. 18. << As mentioned in the previous paragraph, the Moneyweight Scale Co. was started in 1899 as the selling company of the Computing Scale Co.

Superficially, the records suggest that the Money-weigh Scale Co would have stopped trading in 1901, when the Dayton Automatic Scale Co started. This bill is dated 1902, so more re-search is needed to find out when this company name was discontinued.

This is the perfect example of how reality does not match theory!

It is interesting that the eagle is holding the beam of the type owned by the author, and not one of the spring drum computing scales also made by the Computing Scale Co. Was the company predominantly making beam scales? Can any ISASC member add to our information?

Courtesy B Doniger

By 1934, the Dayton Scale Company had become a division of the Hobart Manufacturing Co, which specialised in technology for the food industry.

According to patent records, shortly after 1904 the Computing Scale Co. management had begun working on a combined weighing, computing and printing machine. Work on the "ticketing machine" continued under Watson at IBM and Hobart executives James Ogsbury and Burns Dreese. After checking every computing and multiplying device in business machines and other applications of computers throughout the world, as well as devices of the types used for instantaneous calculation of data for aircraft and anti-aircraft gun aiming systems, they worked out a unique and successful solution in their own Dayton, Ohio, headquarters.

This machine, known as the Hobart Dayton 2000 system, was introduced to the American market in the mid-1950s. It is an electrically-operated scale interconnected with a computer and printer labeller unit so that a series of random-weight packages containing the same commodity can be weighed, their value computed at a predetermined price per pound, and a printed label issued automatically and attached to each package in mere seconds.[9] This system, advertised as the marvel of the pre-packaged age, has revolutionised the way we shop for groceries. Today, 106 years after its founding, the firm is owned by the PMI food equipment group, a holding company based in Troy, Ohio. And the Hobart Dayton 2000 System, like its direct ancestor the Moneyweight Scale, has played an important role in American and international marketing.

Notes and References

1 Pitrat family records on file at the Gallipolis Historical Society; Sanderson documentation supplied by the US Patent office; Culmer records from the New Brighton, PA Public Library.

2 Ozias improved the scale in 1900/1901, adding a device that warned when the scale was near to equilibrium, and giving the user the signal to start moving the rider-poise. See Fig. 15.

3 The patents of Julius E Pitrat are fascinating, and are to be illustrated in a future EQM.

4 Meeker, D. *Better Eating from Start to Finish: The Story of the Hobart Manufacturing Company.* New York, San Francisco, Montreal: The Newcomen Society of America, 1960, 19.

5 Meeker, D.
Roberts, J, *Weights & Measures*, Chas Knight & Co, London, 3rd ed 1908, 90. "*...the Dayton Co.'s Moneyweight scales...are adapted for such articles as fruit, meat and especially bread. Both steelyards should be tested and stamped.*" Page 282, "*all stamped before 1.1.1908, may be continued and restamped (if complying with old regulations) until 30.9.1912, and may be subsequently be continued in use until they become inaccurate and stamp is obliterated, although they do not comply with this [1907] regulation.*"

6 Cunliffe, H, & Owen, G A, *Notices 1 to 250, issued by the Board of Trade 1904-1913* annotated, London, 1927. See EQM, p 2209.

7 Gallipolis Historical Society, private correspondence.

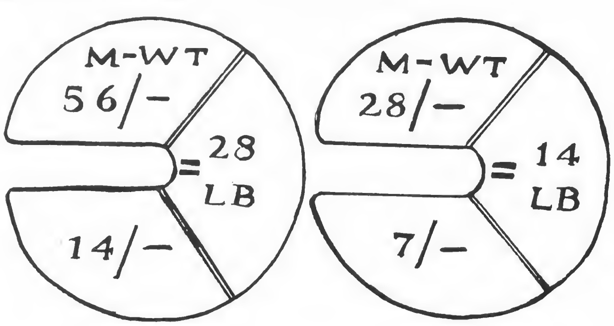
8 *Current Biography: Who's News and Why*, 1950. New York: H. H. Wilson Co, 1951.

9 Rangeley, A, (ISASC member) private communication. W & T Avery produced their version, Model 1701, Autocrat Weighing Machine with intregral ticket-printer for adhesive labels, at £3,500 each, in January 1964. Albert sold the very first machines made to one of his customers that January.

Author's biography.
Ben Smith spent his entire working career in the natural-gas pipeline business. He became attracted to scales while helping his wife Mary scout for the John Deere memorabilia that she collects. He enjoys taking his scales apart, studying the relationship of the various elements, and restoring them to perfect working condition. His collection, while varied, emphasises computing and counting scales for both retail and industrial use. His talent for learning the past history of each scale-maker and the identities of successor firms is especially appreciated by collectors.

Notes & Queries

N & Q 133	from J CARTER



I have two brass cased weights from a price-computing scale. Can any further evidence be added?

Fig. 1. Brass cased weights, the heavier weight on the left being $^{7}/_{8}$ ins thick, and the lighter weight on the right being $^{1}/_{2}$ ins thick.

Reply	from the editor

Until the article on the Computing Scale Co came from Ben Smith, I could have added nothing.

Possibly these weights came from a scale by one of the competitors of Computing Scale Co. such as the company that D Myers worked for, (see fig. 2). He patented a scale on Jan 12th, 1897, that is another candidate for being the one for which you have the weights.

This drawing is so similar to the ones for the Computing Scale Co that one wonders about plagiarism. Can any member say which company made this scale?

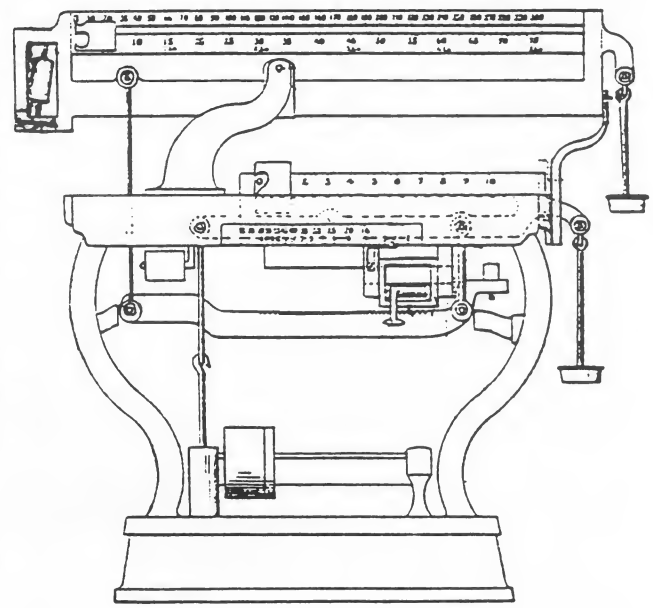


Fig. 2. >> Patent no. 822, of Jan 12th, 1897, taken out by C Junge on behalf of D Myers.

Contemporary Comment 1913

Cunliffe & Owen annotated the Board of Trade notices issued between 1904 and 1913, in their inimitable style, and the comments were published in 1914. A second set of annotations was published in 1927, without any reference to the person who made the comments, but it is assumed that the same authors were responsible. These comments came from the second set, although written for the first set. They referred to the machine 'Royal Computing Spring Weighing Instrument', submitted to the Board of Trade in May, 1905, which machine failed to meet the criteria demanded. Because of the similarities with the Computing Scale Co. machines, it is probably by that company.

"The introduction of a weighing instrument for use for trade which would also calculate and indicate the value of a commodity at a given price per pound represented an entirely new principle, both of construction and of use. For this reason we may be permitted to digress from the main purpose of this book in order to insert a brief historical note indicating, in the barest outline, the evolution of the price-computing weighing instrument.

The advent of these instruments as suitable for the purpose of ordinary retail trade in this country only preceded the passing of the Weights and Measures Act, 1904, by about six years. At that time they were exclusively of American manufacture, and remained so until within quite a recent date. The instruments referred to in Notices 3, 4, 8, 9, 24, 36, 39 and 57 were all American machines. But while the task of bringing these instruments up to a point of comparative perfection must be placed to the credit of American ingenuity, the conception of the idea of a weighing machine which would also indicate price values can be claimed, perhaps not exclusively by Englishmen, but certainly by them concurrently with the inventors of other countries. As far back as the year 1863 a patent was granted to N R Hall for a postal balance which was a value-indicating device....From this point onwards the references in the British Patent Office records to price and value-indicating appliances gradually increase, becoming particularly numerous between the years 1895 and 1902....

For the twenty years succeeding the granting of a patent to Hall's postal balance, every effort in the construction of price-computing machines was based on the lever principle. In the year 1883 the first price-computing machine on the spring-balance principle was introduced; but machines on the lever principle nevertheless continued to be patented, although in more recent years, with the exception of the

combined lever and pendulum, their number has gradually declined. In every case, apart from the pendulum scales, a simple steelyard suitably mounted, or a compound lever machine, was adopted. Much ingenuity was expended in attempting to overcome the obvious difficulty of combining a price-indicating apparatus with a type of instrument not self-indicating for the purpose of weight. Gathering these lever machines into groups, they may be summarised under four heads:

(1) Those with a fixed horizontal chart or scale parallel to the travelling poise. Perhaps, so far as this country is concerned, the best-known pattern of this type was that of W F Stimpson-an American machine which was put on the British market about the year 1900.

(2) A combination of steelyard and drum, the steelyard being used to record the weight and the drum the price values. The rotation of the drum was generally effected by a governing screw; or by a screw and cog-wheels combined; or by the drum revolving on a screw and serving as the poise on the steelyard. The two former are not known so far as the Board of Trade Notices are concerned, but a specimen of the last-named type is illustrated under Notice 98.

(3) The platform machine principle pure and simple. The best-known specimen of this type was that introduced into this country by the Computing Scale Co, Dayton, Ohio. Since the passing of the 1904 Act, none of these machines has been stamped for use in trade in Great Britain.

(4) The lever and pendulum machine. This type first appeared in 1900. To begin with, they were exclusively of American manufacture, although in fairness to British inventive skill it should be pointed out that in May 1900 a patent was granted to T Evans, a Welsh grocer, who brought out a price-computing machine on the pendulum principle, and combined therewith a drum for registration purposes. In this latter feature Evans was in front of the Americans, but his patent never seems to have been put on the market.

Value-indicating machines on the spring-balance principle, and from which the instrument in this Notice 3 has evolved, did not begin to appear in the British Patent Office records until the year 1883. The first pattern was of the simplest form, being merely a "straight-down" spring balance for postal purposes. On one side of the vertical slot the scale was divided into weight graduations, and on the other into value indications showing rates of postage.

The next step was taken in 1886, when H Pooley patented a dial weighing machine for use on railways in determining the charges for excess luggage. The dial had four concentric circles, the outermost being graduated into weight divisions, and the three innermost into rates for first-, second-, and third-class passengers respectively. From this date onward for the next thirteen years every type of value-indicating machine on the spring-balance principle (and there were many) was based on the dial for the purposes of weight and money indications-except in one case where an inventor harked back to the "straight-down" principle.

It was not until the year 1899 that the Computing Scale Co of Dayton Ohio, USA, patented in this country what in effect was the same machine as illustrated under Notice 3. It is somewhat surprising that the drum or cylinder was so long making its appearance in this country as adapted for use on a spring-balance computing scale, because it had been known in America for many years previous to 1899-the first spring-balance price computer on the cylinder principle appearing in the year 1870, when a patent was granted by the United States Patent Office to W H Phinney, of Pawtucket, Rhode Island. Moreover, it had been known in this country for many years prior to 1899, as adapted for use on lever machines, and one wonders why it was so long in coming into its own in this country. As a principle of registration, permitting as it does a wide range of prices and ample space for value indications, it is now acknowledged to be the best, and is utilised on both "spring" as well as "pendulum" machines."

The Science of Weighing Yesterday

Part 3

BY W A SCHEURER

Illustrations and captions by D F Crawforth-Hitchins

Revolution in the Heavy Load Receiver

Almost all of our outline of the long history of the development of scales and weights has been concerned with two of the basic scale elements, sensors and readout. But the increasing need for accurately weighing heavy loads required a new principle.

Until recent times, and even today, huge steelyards were used to weigh very heavy loads. However, it was time-consuming and inconvenient to unload a cartload of material onto the load receiver and then reload the cart. It was simpler to weigh the cart empty and loaded, then calculate the difference. Even so, this meant the tedious chore of unhitching the horses. (See EQM, p 655-61, 692-99 and 721-27.)

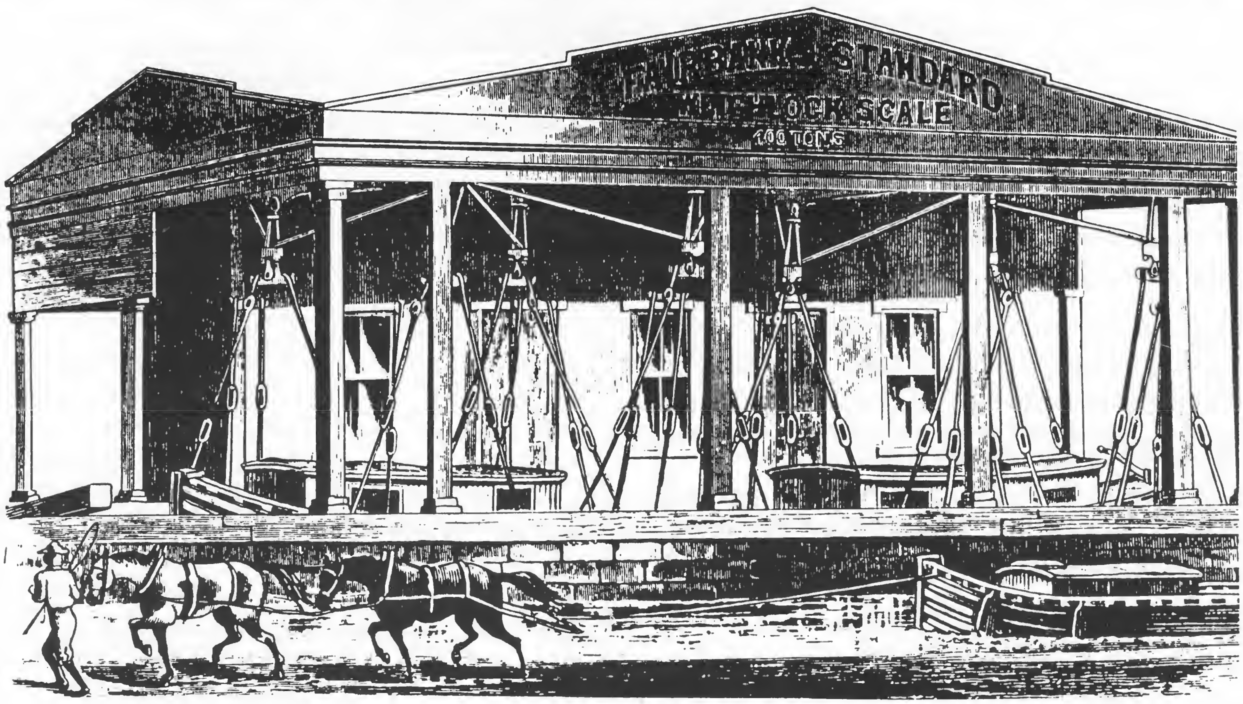


Fig. 1. Fairbanks Weighlock Scale, an overhead lever system, was the largest scale of the canal era, used to weigh loaded boats on the Erie Canal. The boat was diverted off the main waterway into a lock, to float over the cradle of the scale. The water was removed from the lock, leaving the boat swinging in the air. When the weight of the boat had been recorded, the lock gates were opened and water again supported the weight of the boat. This scale had a capacity of 400 tons. Date of installation not known.

The English Turnpike Act of 1741, which provided for the collection of tolls on the basis of vehicle weight, provided the incentive to find a quick, easy method for weighing heavy loads. The solution came with John Wyatt's invention of the first true compound lever platform scale. This first platform scale called a "weighbridge", was built at Birmingham, England, in the 1740s. The platform was flush with the road and the cart was simply halted on it and weighed immediately.

The weighbridge consisted of a large load-receiving platform and two large V-shaped levers which were pinioned through their apexes to one end of a third lever. The opposite end of this lever held a small circular table upon which were placed the various weights. Each V-shaped lever was supported with its ends resting on pivots. The platform supports rested on the V-shaped levers some distance from the

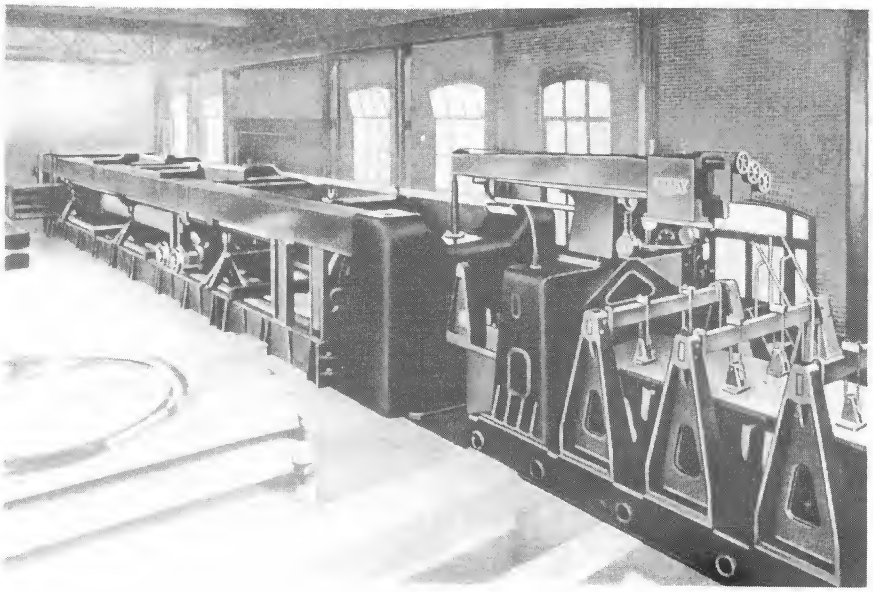


Fig. 2. W & T Avery Ltd made this horizontal compound-lever machine especially to test the huge models made to check the design of the Sydney Harbour Bridge before the bridge was constructed.

The machine had a capacity of 1,250 tons! Wyatt might have been surprised that his system could be applied to such vast loads.

H Pooley patented the linking of several platform scales together by 1847, demonstrated in a drawing in *The Mechanic's Magazine* of December 25th, 1847, page 615.

ends. (See EQM, p 657.) The principle of the platform weighbridge is that a load at any point on the platform is transmitted equally to the load end of the third lever and can be balanced by the weights at the opposite end. The V-shaped beams are levers of the second class in which the load is applied between the fulcrum and the power point. The power point of this system then becomes the load point of the lever of the first class, since the fulcrum here is between the load point and the power point.

Wyatt's compound-lever platform scale principle is used in most modern vehicle weighing machines, for it has the advantage both of equal transmission of the load at any point on the platform, and of the fact that the platform is always in a horizontal position.

The Ratio Beam Scale

In the 1820s, the American, Thaddeus Fairbanks, made the next important advance in scale history by combining the compound-lever platform with the steelyard to produce the ratio-beam scale for convenient weighing of heavy loads.[1]

Fairbank's method of using fixed and sliding counterpoises replaced Wyatt's circular table with its loose weights.[2] Soon the weight end of the steelyard beam was formed into two parallel beams so that heavy counterpoises could be positioned along the lower beam while lighter weights were moved along the upper beam for a fine reading.

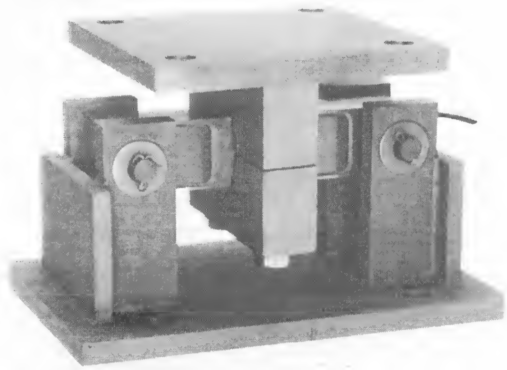


Fig. 3. Fairbanks' modern version of the scale above. Many of these Omnicells, each put under a level support, can be read at one point. Each cell has a capacity of 25,000lbs, so 36 of these little objects could do the job of the enormous scale above.

Combination Scales

No less revolutionary than the discovery of the basic weighing principles is the combination of various principles to form families of scales for particular uses. For example, the compound-lever platform was combined with the self-indicating pendulum and circular reading face to produce the modern scale for weighing people.

Semi-self-indicating platform scales combine pendulum resistance with sliding counterpoises. Typical retail counter scales may use two pendulums rotated by a rack and pinion system, or a cam fastened to the lever system by a steel ribbon. A pointer attached to the cam swings through an arc to give the readout on a fan-shaped chart.

The Self-computing Scale

The purpose of most retail scales is to show price as a function of weight. In the past it was left to the clerk to multiply the indicated weight by the price per unit weight. Early in this century the self-computing scale was designed to indicate price as well as weight automatically.

Price computation is purely a matter of readout, and two new types of readout were devised. Both consisted of a chart, or matrix, in which weight was indicated by horizontal rows and price by vertical columns. In the fan-type readout, the total weight of the item was shown at the top of the pointer while the total price was read off at some point down its length. The drum-type readout was a rotating horizontal cylinder which came to rest when the weight balanced the load. Price and weight were indicated through a window stretching along the length of the drum.

Both readout systems are widely used in counter scales. They mark a significant advance in the science of readout because they quickly show the price for any one of a wide variety of items.

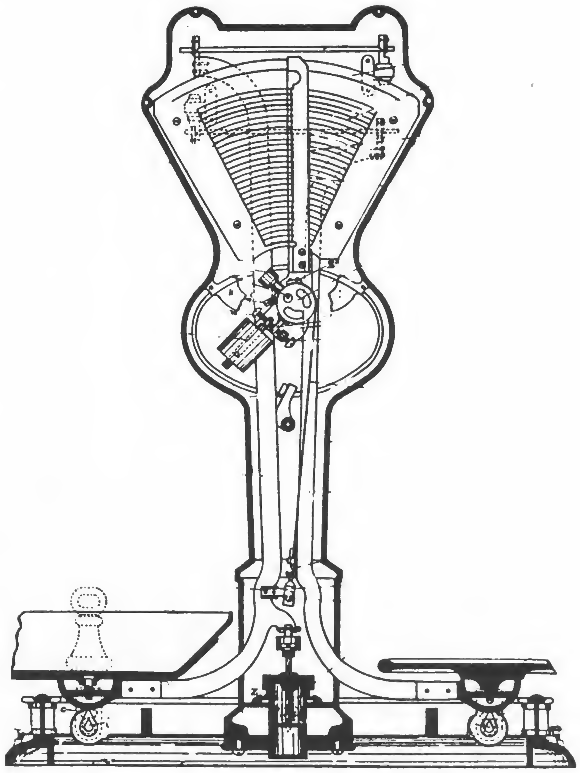


Fig. 4. Semi-self-indicating scales seem to have originated in America. The Computing Scale Co got approval from the Board of Trade to sell these handsome and practical scales in Britain in July 1906.

Described by the Board as a combined even balance and pendulum counter weighing machine of 14 lb capacity, to calculate and indicate up to a weight of 2 lb the value of the goods weighed. The dashpot in the centre was filled with glycerine. They were heavily plagiarised, for example, by Day & Millward in their 1924 catalogue.

The Great Turning Point in the History of Weighing

Looking back over our outline history of the significant revolutions in scale development, we can summarise these momentous advances in terms of the three basic scale elements: 1) the progress in the evolution of the load receiver from the primitive cord-suspended basket to the delicate knife-edge suspension of the modern pan balance; the Roberval linkage which permitted the pans to be fastened directly to the beam ends above the fulcrum while always remaining in a horizontal position; and the development of the compound-lever platform for the quick, convenient weighing of heavy loads; 2) the long series of improvements in load sensing, culminating in the self-indicating scale; and 3) the evolution in readout systems from the arbitrary judgement of the human eye to the self-computing scale.

Two significant facts emerge from these observations. The first is that all of these advances have been mechanical. They depended upon the use of simple levers, compound levers, pendulums, springs, and pointers. The second is that, up to this point, the function of the scale was simply to weigh and indicate weight, or weight and price. The scale was a system in itself.

From World War I on, and particularly during World War II and the years immediately preceding it, the science of weighing was completely revolution-ised. This revolution was to affect all three scale elements, load receivers, load sensors, and readout. And it changed the scale from a system in itself to the scale as a component in much larger systems which carried out many other functions besides weighing. Yet the scale would remain as the brain and nerve centre of these complex new systems.

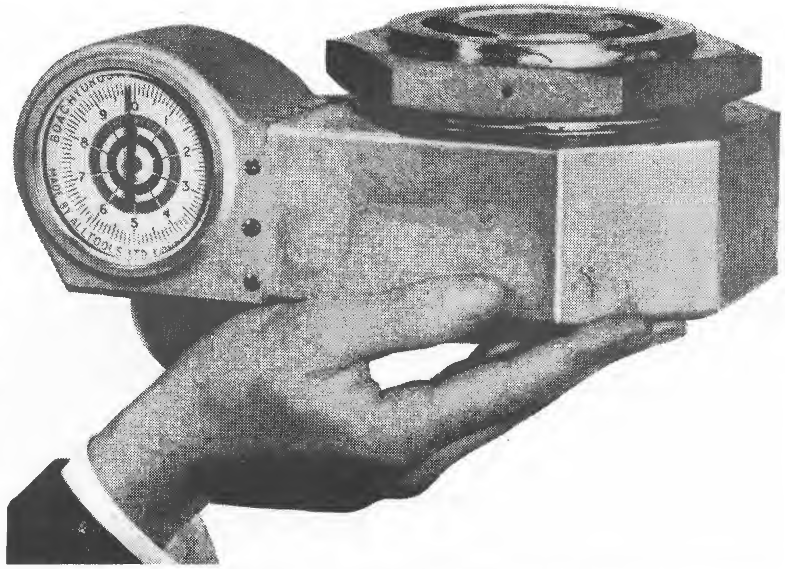


Fig. 5. Alltools Ltd, BOAC Hydrostatic Weighing Unit, 25 tons capacity. New in 1952.

Printed Readout

Symbolic of the new age was the combination of the scale with some form of typewriter to give a printed record of the readout, an achievement of the 1930s.[3] Today the meats and cheeses in almost every supermarket are automatically weighed, packaged, and marked with a printed ticket showing weight, price per unit weight, and total price.

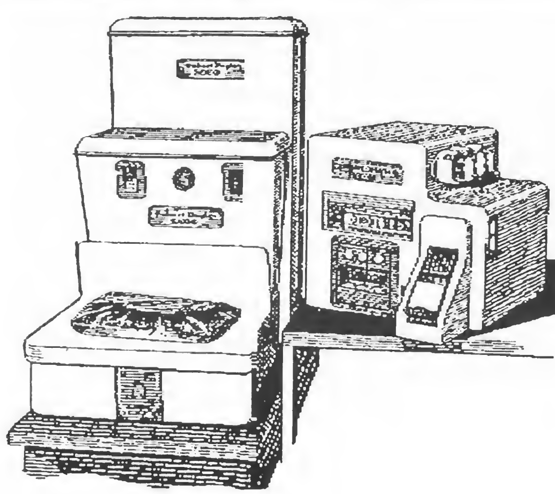
The Automatic Scale

The automatic scale is another example of the scale as the control component in a system. Generally called "batch weighing", the scale not only weighs material in a continuous flow, but controls the amount of material in each batch so that it will meet a predetermined weight. Here the load sensor is also the load controller.

While the first automatic scales were in use at the end of the 19th century, they more properly belong to the new era of mass production and automation.

From Mechanical to Electronic Systems

The transformation of the scale from a system to a component in a system has paralleled the transformation from mechanical to electronic technology. Electronics has completely altered the structure and operation of the basic scale elements. It permits us to weigh much heavier, as well as lighter loads accurately and quickly. See fig. 3. Electronic load sensors are so refined that readout is only possible through electronic instrumentation.



The Load Cell

The load receiver in the past has almost always consisted of a platform or pan joined to a lever system. It transmitted energy from one point to another. The load cell transforms energy from one form to another.

Fig. 6. The Hobart Dayton 2000 System introduced in 1956. The electrically operated scale is connected to a computer and printer-labeller unit so that a series of random-weight packages can be weighed, their value computed at a predetermined price-per-pound, and the printed label issued automatically and attached to each individual package in seconds. Courtesy B Smith

It is therefore often called a transducer. The thermostat which controls the temperature in your home is a transducer, transforming heat energy into control energy. The cell in your photographic light meter transforms light energy into the electrical energy which actuates a mechanical pointer.

Fig. 7. Mettler, Model A 30, 1978. Automatic analytical top-loading balance with electronically controlled electromagnetic force compensation from 0.0000 to 30.0000g. Strictly speaking, this was not sensitive enough to be called an analytical balance, but the top-loading saved time during the weighing process. Since 1978, further developments have brought the performance up to at least equal earlier mechanical instruments.
Courtesy H Jenemann

Modern electronic load cells usually employ a strain gauge. This sensor makes use of the principle that the resistance of an electrical conductor increases with tension and decreases with compression. Such a cell consists of perhaps five inches of fine wire, one-thousandth of an inch in diameter, arranged as a grid no larger than a postage stamp. When the grid is compressed by the pressure of a load, the electrical resistance of the wire is decreased, and the current flows more freely. The difference in resistance is measured in terms of the weight of the applied load.

The strain gauge load cell can be used to weigh very heavy loads by making use of another principle. This is the fact that a steel column is deformed in direct proportion to the amount of stress, or pressure, applied to it. That is, the steel column can be compressed like a spring but the contraction of the column is so slight that it can only be determined by very sensitive means. For example, a load of 50 pounds on the column may compress it only twenty-five millionths of an inch.

A strain gauge bonded to a steel column provides a compact, fast-response system for weighing loads, such as heavy vehicles, railroad cars, or even whole lengths of track. The strain gauge combines load receiver and load sensor into one unit. This is a revolutionary advance.

The Differential Transformer

Another new type of load sensor makes use of the principle of electromagnetic induction, discovered by Faraday, a century and a half ago. A bar magnet moved through a coil of wire sets up an electronic current in the wire. The differential transformer consists of a tiny iron bar fastened to the load receiver. The load moves the bar through a coil of wire, changing the inductive coupling between the primary and secondary windings of the coil. The change in electrical signal, both in amplitude and phase, is proportional to the distance the bar is moved by the load, and can be read out on a meter.

From the Past to the Present

Having come in our historical journey from those prehistoric mists of the past, through those scattered records of thousands of years ago and the confusing abundance of information on the recent past, we stand now at the doorway to the present.

Our feeling must be one of wonder at man's ingenuity and perseverance as he has transformed the Egyptian balance into our modern systems of incredible complexity, accuracy, and flexibility. Yet we can also observe that each new device did not supersede the others, for the equal-arm beam is with us today as it was thousands of years ago. And throughout the world many a woman weighs fish on a steelyard almost identical to that used in ancient Rome. The simplest types of Roberval and Beranger scales are still found on retail counters everywhere. So we may say of scales, as we cannot of humans, that most of the past generations are still with us in the present.

Throughout our story we have shown time and again that the greatest developments in weighing machines occurred in those nations which were rising to a dominant position in commerce and technology. Thus it is no chance coincidence that the great revolution in scale elements and automated systems is taking place chiefly in the United States. For this revolution was born of the invention of interchangeable parts by Eli Whitney, of the production line by Henry Ford, and of the electronic computer by the scientists of IBM and Harvard.

Ours is not only the history of the science of weighing, it is also the history of the increasing importance of that science. For the need and the desire to weigh almost everything has become so much a part of our civilisation that we are scarcely aware of it. Yet if we begin with our own persons and extend our thinking to our environment, we find that everything we eat, everything we wear, every material in our houses, in the cars we drive, and the roads they travel, has been weighed at some point in its processing. More than this, our whole society, with its systems of government, codes of law, its huge cities, and its astonishing technology which is now reaching through space towards other planets than ours: all of these are unthinkable and impossible without an accurate standard of weights, and devices for measuring those weights.

Nothing, perhaps, is more symbolic of the meaning of weights to civilisation than the age-old figure of Justice holding in one hand an equal-arm pan balance, with her eyes blindfolded so that she will not let her emotional judgement interfere with the impartial verdict of the scales.

The Bible makes it clear that a solemn and heavy responsibility has been placed on those of us in the scale business. But it implies that, if we live up to this responsibility, we will also live longer than others. For it says, "*But thou shalt have a perfect and just weight, a perfect and just measure shalt thou have; that thy days may be lengthened in the lands which the Lord thy God giveth thee.*"

Notes and References

1 Editor:- Steelyard beams with sliding poises were attached to platform scales well before Fairbanks thought of his ideas. See EQM, p 696, for a compact design by Jacob Haas, made in London in the 1790s.

2 Editor:- Loose-weight steelyards or unequal-arm beams were attached to platform scales by J J Merlin, T Weekes, T Bourne, W C Day and others before 1830.

3 Editor:- Scheurer was probably thinking about industrial weighing or shop weighing. Printing devices were applied to coin-operated person scales from their beginnings. P Everitt patented such a combination in 1884, and thereafter many similar machines had the facility to print a ticket. C Schenck patented a printing mechanism to apply to a coin-op person scale in 1888. The first application found for printing on a factory scale is the patent by W E Richardson of 1888. He patented a platform scale with "a continuous register of the sum of weighings....and a printing strip or series of tickets". It was not until 1930 that H Pooley & Son Ltd gained approval from the Board of Trade for a robust platform scale to check the output of quarry workers and print a record.

First presented before the 50th National Conference on Weights and Measures, Washington DC, June 23, 1965, sponsored by the National Bureau of Standards, US Department of Commerce. It is reprinted with the kind permission of the International Society of Weighing and Measuring. The illustrations were found by, and the captions have been added by the editor to enable members to visualise the esoteric items discussed in principle by Scheurer.

Review

La Massa e la sua Misura (Mass and its Measurement), International Congress, Modena, 15-17th September 1993; published 1995. 337 pages.

The book consists of the 48 papers presented at this conference at Modena, Italy, in 1993. The official languages were Italian and English. Twenty-seven papers appear in Italian and twenty-one in English, and, save for two, each has an abstract in the other language. The sections are, Historical, (12 papers); Technical-Scientific, (21 papers); Legal, (7 papers) and Didactic, (8 papers). Space considerations forbid a detailed evaluation of all 48 contributions, so attention will be concentrated on those bearing most directly on the aims of the Society and even then, somewhat briefly and eclectically. The papers are mainly from countries of continental Europe. There are only two papers from the UK and none at all from the USA or Canada. The papers are not numbered so will be identified by the number of the first page, e.g. [59]. There is a Table of Contents giving papers by title (all in Italian) but there is no index.

Historical

Appropriately, the first, [3] in Italian, reviews the development of the concept of mass from the 15th century to modern times ranging from Newton's statement *The quantity of Matter* [Mass] *is the measure of the same arising from its density and bulk conjunctly*, to the idea of mass as a measure of the inertia of a body, and the relation between force and acceleration for each body is given by extension of Newton's idea by Euler in 1736 and continued by Mach in 1868. The paper concludes by considering 19th century electromagnetic studies leading ultimately to the 1905 mass-energy equivalence.

[9] in English, is an historical review of balances which use electromagnetic or similar methods of returning the beam to horizontality, the mass being given by the measurement of an electric current (or voltage drop caused by the current) produced in a transducer signalling balance arm movement from a displaced position to horizontality again. These balances are known for their sensitivity, some reading as low as 0.0001 mg.

[21] in Italian, tells of mediaeval balances as described in merchants' handbooks, notably Pegolotti's *Practica della Mercatura*,[1] showing the widespread use of the balance and the statera (steelyard) for commercial weighing. The steelyard is said to have originated in the Middle East. There were large and small balances in use in the various European cities from Constantinople to London, the large for "great wares" in bulk, using *grosso* weights, the small for smaller amounts of high value or *sottile* goods, usually spices and pharmaceuticals, using sottile weights, although sottile wares in bulk (hundredweights) could be measured on the great beam. In Florence and Pisa, the balance was to be used for gold, silver, silk, saffron and all sottile spices, with the steelyard for everything else. In these two cities, weight by the steelyard was to be 2% more than that given by balance "*evidently to compensate for lower precision*." The equivalence of 100lb in London to 138-140lb in Florence gives a Florentine pound of 339.5g, (5239.16 English Troy grains).[2] Mediaeval weighing was a mixture of commercial and political motives. Not only was there grosso and sottile weights, but there were the Doge's weights of Venice and two different machines for weighing. Little wonder that Thomas Aquinas[3] wrote "*When things are plentiful we have more ways of weighing them.*"

[29] in Italian, states that balances collected by individuals or museums are longer used for weighing but stand as testimony to the social and economic conditions of times past. They demonstrate that even in quite early times a surprising level of skill, workmanship and accuracy was achieved. The Museo della Bilancia in Campogalliano has not only a collection of historical balances (two from the late 19th century being shown), but has created a dictionary of terms used in the trade of scalemaker, describing

not only balances themselves but also their component parts and necessary tools. Then [47] in Italian, describes the collection of balances in the Physics Museum of the University of Bologna. Four balances are illustrated, all modern.

The Swedish system of measurement proposed by Stiernhielm [53] in English, in the mid-seventeenth century is described as well as that which preceded his period. Based on Roman measures, 1 amphora = 1 cubic foot = 80 Roman pounds, he adjusted Swedish measures to the later Roman foot of half a cubit. Later the Swedish foot was found to be 1mm longer than the Roman but he was one of the first to attempt a reform of weights and measures on scientific principles.

[59] in English, original in German, is an example of the procedures involved when a known weight, multiplied by a quantity **a/b** yields another known weight, **a** and **b** being integers. An accuracy of four decimal places is claimed for this process, and it is true that there are numerous examples where one weight is $^{15}/_{16}$ of another, or $^{12}/_{16}$ or $^{20}/_{21}$. For example, 20 English silver pennies weighed, by definition, 1 Tower ounce and 21 pennies were the same weight as the Paris ounce, which is given so very precisely by Pegolotti.[4] Of particular interest to this reviewer is the information [61], 50 French poids de marc = 30 Carolingian pondera = 27 English avoirdupois pounds = 48 marks of Nuremberg. Here the Avoirdupois pound is given, to four places of decimals, as 453.2461g. With 15.43236 grains in the gram, the avoirdupois pound would be 6994.66 grains rather than the present 7000. A paper is forthcoming on the masses of the English troy and avoirdupois pound from medieval times to the 19th century.[5] The important roles of the Cologne mark and the pound of Charlemagne are emphasised in this paper.

[66] in Italian, deals with Majorana's theory (evolved 1918-1923) of the diminution of gravity on going through matter and described experiments in this century to see if matter can in fact shield the force of gravity. The question is left open but it has drawn comment from Eddington in 1921 and continues to do so, the latest reference quoted being 1992.

Scientific and Technical

This section occupies more than 40% of the book and consists mainly of papers from national bureaux of weights and measures dealing with professional standards' work, which probably accounts for the fact that of the 19 papers in the section, 14 are in English. Not surprisingly, it deals with weighing to a few parts in 10^9, discusses techniques of cleaning national prototype kilograms and monitors their mass changes with time and especially after cleaning, the results being somewhat discordant with some national standards showing small mass loss but most showing a mass gain relative to the international prototype; [95] in English.

Suggestions are being made to define the kilogram other than by having the primary standard a piece of Pt/Ir alloy. Proposals are being advanced [100] in English, whereby the kilogram is defined atomically, either through a redetermination of Avogradro's number using a measured and weighed cylinder of silicon, having determined its crystalline lattice constants, or by collecting a weighable quantity of a single atomic isotope, e.g. ^{197}Au, from an ion beam whose current is measured so that the number of atoms collected is known; [104] in English.

Standard kilograms during a period of intense use have been shown to experience "*a far from negligible decrease of 10 μg in 3 years*" [124], in English, which amounts to the removal of as much as a crystalline lattice layer of platinum from the base.

Very precise measurements of the ^{28}Si / ^{12}C mass ratio have been effected using a Penning trap [141] in English, yielding the mass of ^{28}Si as 27.9792657(30), ^{12}C being the currently accepted atomic mass standard.

Two papers deal with the very important buoyancy correction [153 and 194] both in English. It is important to realise that a 1kg mass of stainless steel appears about 150mg lighter in air than in vacuum, depending on the air pressure, the temperature, the relative humidity and the concentration of CO_2.

One paper, [174] in English, discusses the British national standard for mass, viz., kilogram no. 18, its mass after cleaning and subsequent re-verification. The assigned value in January/ February was 1kg + 67μg.

Special stainless steels have been and are being developed for the fabrication of mass standards [216] in English, with a preferred density of 8000kg / m^3.

Legal

The first paper here is entitled, *The Balance as a Tool against Commercial Fraud.* [227] in Italian. It is a condensed summary of the uses of specific gravity from Greek times through the centuries. It concludes with a particularly valuable bibliography of 97 works, some with specific references as to pages. Other papers deal with the roles of chambers of commerce, consumer protection with respect to mass measurements by weighing machines, and legal matters in the European Union.

A paper, [265] in Italian, deals with the commercial practice of weighing in air, hence ignoring the buoyancy correction, thus the concept of *conventional values of weighing in air*, or *conventional mass value* is introduced and a scientific definition is attempted.

Didactic

[287] in English discusses the ideas of mass, weight and inertia showing the equivalence of inertial mass and gravitation mass and introduces the buoyancy correction in weighing masses of different densities in air The next paper, [293] in Italian, discusses the role of the Museo della Bilancia of Campogalliano as an instructional centre for elementary school children who can make use of the equipment to learn about measuring things, heights, lengths and masses. Children of this age group can learn about mass and weight in an experimental environment. A further paper on this topic, [325] in Italian, continues this theme with children learning about mass by using simple wooden equal-arm balances.

For the philatelist, there is a paper [319] in Italian, presenting photographs of postage stamps bearing a representation of weight, a metre bar, scales , etc., or commemorating the shift to metrication from a variety of countries form Australia to Uganda.

Much more could have been said about all of these paper but perhaps the above will give the flavour, at least, of the work presented. Its importance lies in showing the historical development and the modern approach to standards, their reliability and stability with future developments as to their definition.

R D Connor

Notes and References

1 Pegolotti, *Practica della Mercatura*, A Evans (ed), 1936.

2 See EQM p 1994 and 2021, where the Florentine sottile pound is derived as 5241.6 grains, in close agreement with the above value.

3 Aquinas, Thomas, *Summa Theologiae, Secunda Secundae*, 77, 2.

4 Pegolotti, ref. 1, p 237. More conveniently, see EQM, p 1991.

5 A D C Simpson and R D Connor, forthcoming.

Lincs with America

BY J KNIGHTS

When it comes to scales I know what I like.

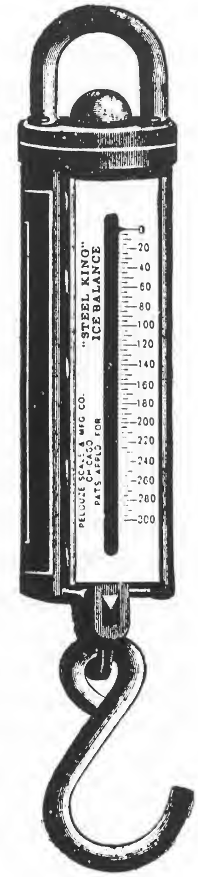


Fig. 1. Pelouze Scale & Mfg Co. ice balance, from Norvell-Shapleigh catalogue of 1903.

Not for me the miscellaneous items of ironmongery banged out on the anvil in the 18th century or the bejewelled and decorous but metrologically inept postal creations that send certain collectors into raptures.

I am mainly 19th century: which does in certain instances stretch into the shallower waters of the 20th; and I am definitely trade.

When I acquire a scale it is usually some great hulking iron job with a trade transfer, a Board of Trade notice and a lead plug with a stamp on it.

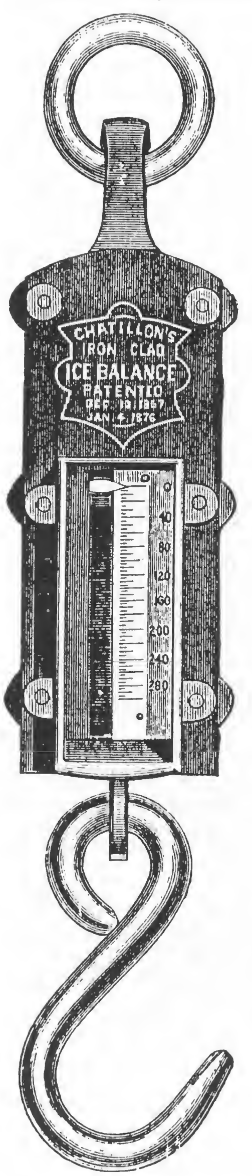


Fig. 2. Chatillon ice balance from the Norvell-Shapleigh catalogue of 1903. Extra heavy, capacity 200 lbs or 300 lbs.

Once you are versed in the technical requirements of an efficient weighing machine, mechanical probity tends to become an essential feature of a desirable machine. If this can be encountered in a device exhibiting pleasing design, tasteful ornamentation and redolence of period etc. so much the better, but the superficials rarely make up for bad engineering.

In the UK there was a golden age of construction round the turn of the 20th century when the approval system operated by the Weights and Measures Department of the Board of Trade ensured that not only did new equipment embody the finest principles of construction but the design of the machines was always *not such as to facilitate the perpetration of fraud*. This principle was embodied in all machines exhibiting novel features, whilst the Weights and Measures Regulations of 1907 endeavoured in more general terms to require the same elements of compliance in the simpler equipment based on traditional patterns.

This system essentially operates to the modern day but of course from a collecting point of view equipment largely lost its appeal some time around the first quarter of the century.

The twin principles of mechanical excellence and transparency of operation certainly gave rise to a high quality product amongst the plethora of manufacturers who plied their trade within these isles and one is always struck by the quality of a British trade machine when compared to those produced by most (but not all) of our continental neighbours.

If any criticism can be made of the machines produced during the Edwardian period [1901-1910], it must be that they are a little on the boring side. In their drive for probity the examiners at the Board of Trade verged at times on the obsessive in their desire to allow nothing that was too novel or outside best practice as they understood it. Thus one sees equipment of novel, or dare one say it, foreign, aspect being cast aside in the rejection notices, as *not satisfactory*. From a collecting point of view the golden age had actually been a few years earlier

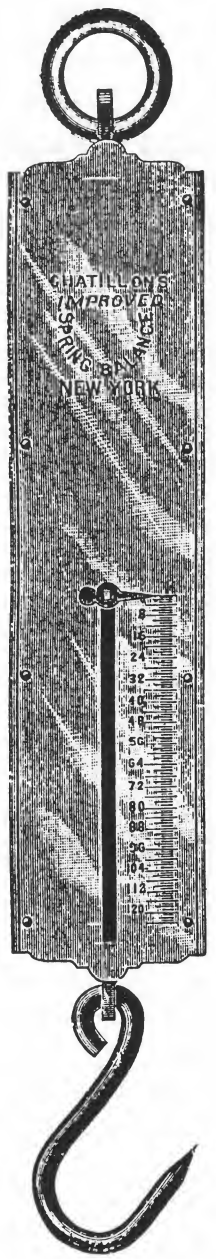


Fig. 3. Chatillon's extra quality ice bal, Class A 2. 1924 catalogue. $72.00 per dozen.

in the so-called Model Regulation Period, when scales were first liable to verification under the Act of 1889 but not subject to pattern approval. Between 1890 and 1907 therefore, many novel and collectable patterns were sanctioned for trade use which were summarily given the chop when the later, harsher regulatory regime was introduced. (See pages 2209 to 2210.)

Some of the patterns that were around in 1890 and which were initially permitted, later failed, not on the mechanical excellence criterion but rather on the transparency of use test and their perceived ability to deceive the customer. Some of these patterns were American!

It is to America that I as a collector sometimes look with some envy as their concept of an acceptable pattern was clearly more adventurous and liberal than was that of the somewhat anally retentive gentlemen at the Board of Trade who, in the retail sector at least, were violently opposed to any pattern that was mechanically adventurous or even marginally consumer-unfriendly. Not for the British then, were contracting scales, counter machines with side beams, ball scales, union scales and various other bizarre patterns sometimes glimpsed in the background of O Winston Link photographs. That same photographer incidentally also did a nice line in those icons of the 1930s, the sub-divided container petrol pump which was big in America but only touched these shores fleetingly before being supplanted by the electric flowmeter. I recall back in the 1960s sitting in a darkened cinema watching Faye Dunaway as Bonnie Parker, posing seductively by such a device and being, I imagine, the only man present who was more interested in the petrol pump.

To return to American scales however, my musings took corporeal form recently in the little town of Horncastle.

Horncastle is in the English county of Lincolnshire, a rural shire described by Henry VIII as *the most brute and beastly of the whole realm*. At the time, the Lincolnshire peasants were revolting; and some are still pretty revolting (only joking, peasants); but it is now actually quite a pleasant part of the realm. Horncastle boasts an unduly large number of antique shops and it was in one of these that I came upon my unexpected piece of Americana. The term 'antique' is rapidly becoming debased to include all manner of tat and trivia and it was amongst the general detritus of this rural emporium that I saw a spring balance like no other I had ever seen. In the UK spring balance means Salter; with a sheet-steel body and a brass face. The balance that hung on the wall was cast-iron and all-American. So much was apparent from fifteen feet even to my inexpert eye, and closer examination confirmed this. The name embossed on the round plate was CLIFFORD WOOD CO. CHICAGO ILL, HUDSON NY, BOSTON MASS, and in the centre was a seal stamped APPROVED NEW YORK CITY, TYPE 34 SERIAL 1. The

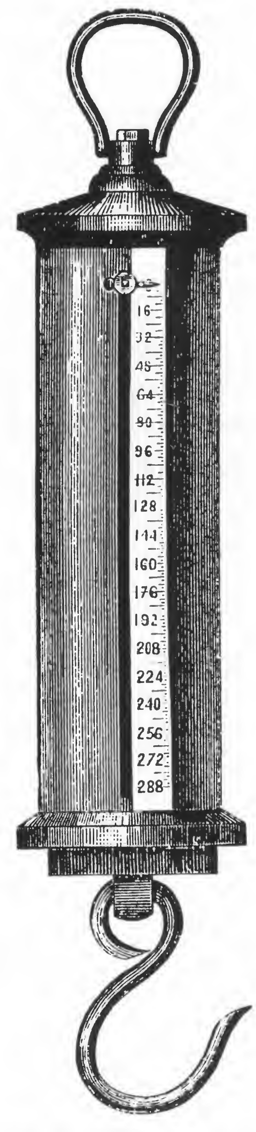


Fig. 4. Chatillon tubular ice balance, Class B. 1924 catalogue. $210.00 per dozen. Obviously a superior product.

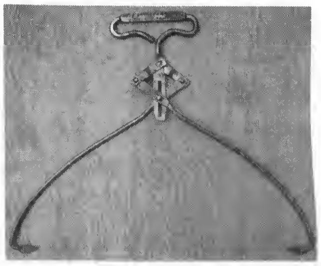


Fig. 5. Ice tongs, self-gripping. Photo Earl Willard

straight pull scale with its 200 lb by 2 lb divisions; lest there remained any scintilla of doubt; was engraved MADE IN USA.

The seller informed me that it was an ice balance, and given the somewhat coarse resolution of the scale, indicating it was used for a low-value commodity and having recollections of Laurel and Hardy doing strange things with large blocks of ice resulting in utter chaos, it seemed a feasible proposition.

In this country of course, prior to the advent of the domestic refrigerator, it was only at the grand house with its own ice cellar, that ice was a feature of the domestic routine so the whole concept of retail trade in ice is totally alien to the British. Having now acquired this scale, I am left with a number of unanswered queries - the penalty of buying things you know nothing about, but knowing there is a large and knowledgeable Equilibrium readership on the other side of the Atlantic, I anticipate that these may yet be resolved.

I find it hard to estimate the age of the machine, although I'm guessing 1920s or 1930s; does the New York stamp indicate an approval for trade use?; were scales approved only for certain trade purposes?; what was a type 34?; what on earth was it doing in Horncastle etc., etc.?

Editor– could ice have been weighed for the North Sea fishing boats?

Buying Ice

Information from J R KATZ

I remember having to go for ice when the supply in the soda boxes of my family's corner store ran out. Mostly that happened in the beastly hot days of summer. I pulled my wagon [trolley] to the ice house some 3-4 streets away. There, the ice was sold by the block, analogous to your cubic yard. A block was something like a 1½ foot-sided cube. The block of ice was chopped from a longer block of about 6 or 8 feet long. There were oversize blocks available at correspondingly higher prices. I don't remember sales being made by weight, and I can't remember whether the ice house I went to could provide home delivery, but there were definitely ice wagons or trucks which did provide home delivery. These same merchants also sold coal. Depending on the size, I can recall the ice being carried by ice tongs, but then for larger pieces it was wrapped in a large sheet of burlap and slung over the delivery man's back and carried that way.

McArthur, Wirth & Co of Syracuse, NY, suppliers of shop-fittings, sold their refrigerators in 1900 with the number of pounds of ice needed (to keep the show-case cool) being specified. For example, their double-glazed show-case 41 x 24 x 43 inches needed 175 lbs of ice.

You do quite often see ice scales lying around fleamarkets and junk shops here, made before I was born. They were very sturdy cast-iron housings and were available in capacities from 100 to 500 lbs. Norvell-Shapleigh's catalogue of 1903 showed Pelouze straight-faced ice balances; Chatillon ice balances, (that had patents for 1867 and 1875); and the

Fig. 6. >> The card that the customer hung in the window, specifying in inches the dimensions of the ice block required for their refrigerator. An ice pick was used to trim the block to the exact size needed.
Photo Earl Willard

German Crab mancur ice balance (EQM page 1863). It is amazing that mancurs were $12.00 per dozen whereas the Chatillon was $66.00 per dozen, for the same capacity, in 1903.

You have already published Chatillon ice scales on EQM pages 1595-1597, but without the interesting note that Chatillon included in their 1924 catalogue. With the ice balance you show at the top left of page 1597, you omitted "*Vulcan Ice Balance with Double Dials patented Feb. 4, 1913......If at any time the pointer should not stand at 0 mark, it can be adjusted by loosening screws in upper cap* [an arrow points to the screws], *turning cap to left or right as the circumstances may require, and tightening screws.*"

Fig. 7. Capacious refrigerator, 28¼ x 20 x 53½ ins (710 x 500 x 1042 mm) made in 1908, needing 65 lbs of ice. With the ice taking nearly a quarter of the space, and the insulation (mineral wool, asbestos and hair felt) in the ash-wood cabinet taking another quarter, there was little room available for the food. At that time they were still coating the linings with enamels containing white lead, oil or turpentine, which gave off foul smells, but this manufacturer had started to use stove-enamelling for the interior, and he made much of this novel feature! They recommended having an ice compartment bigger than the block of ice, so that milk, water and other products could be placed beside the ice.

Contemporary Comment, 1916

Information from The Scale Journal

A manager of an ice company in Webb City, Mo, has issued a statement in his local paper requesting that consumers see that ice is weighed correctly. He states that although the hot weather causes shrinkage, it is his desire that all his customers receive full weight.

Advice to W & M Inspectors, 1910

Taken from W & L E Gurley *Handbook for Sealers.*

As there is no weighing or measuring instrument made that is absolutely accurate, the amount of tolerance the sealer shall allow is a difficult question to decide. In general it may be said that the sealer should use his best judgment on tolerances, taking into consideration the value of the commodity which is weighed or measured by the instrument. It is obvious that if a scale is used in weighing a commodity worth $2.00 per pound, it should be tested to a finer degree and condemned if it does not respond to a smaller test weight than a scale that is used in weighing a commodity worth $0.05 per pound. In this connection the sealer should not allow too coarse a scale to be used in weighing the higher priced commodities at retail. A spring scale upon which the smallest graduation is ¼ pound should not be used for weighing butter by the pound.

The tolerance tables given ...... are merely suggestive and are based upon the value of commodities sold in the average retail store. The weight tolerances are intended for the weights on equal-arm grocery and provision scales and should in no case be used when testing platform scale weights, as these should be adjusted as fine as the sealer's portable balance will allow. It is advisable that the sealer note in a small book all suspicious circumstances and violations of the weights and measures laws, which should be transferred to the office records. These can be referred to at any future time and will be a great aid in prosecutions.

Notes and Queries

N & Q 134 Coin or Bullion Weights? From S POMPER

I recently acquired these two square weights, which taper down to a smaller square base, in a style similar to the apothecary weights in large hydrostatic scales. The 2 guinea weight measures 19 x 19mm, and the 5 guinea weight measures 24 x 24 mm. The numbers are engraved on, so presumably the maker made only a few examples.

Paul Withers tells me that coins were minted in these sizes intermittently between 1668 and 1777, and the coins circulated until the beginning of the 19th century, but Paul has never seen the weights needed to check these coins. He assumed that such weights existed, and is hoping that these two are the first evidence for coin weights for 2 guineas and 5 guineas.

I assumed, before learning this, that they were bullion weights, perhaps from a set starting with ½, ½, 1, 2, 5, 10 guineas, or something similar. As I have not found any other weights from this set, I am reluctant to draw conclusions as to whether they are coin or bullion weights. Can any member enlighten me?

N & Q 135 From D SCHOENLY

Please explain the instructions in my DeGrave & Son folding coin balance.

N & Q 135 Reply From the editor

Both turns towards the centre for a seven shilling piece. The seven shilling coin ($^{1}/_{3}$ of a guinea) was the lightest coin checked, so the poises had to be flipped towards the fulcrum. *The small turn thrown back for half a guinea.* The $^{1}/_{2}$ guinea was a bit heavier, so the smaller poise was flipped towards the end of the steelyard to add some mass. *Both turns back for a guinea.* The guinea was the heaviest coin, so both poises were flipped towards the end of the steelyard to add maximum mass. *with the slide at the cypher.* The little piece of flat brass (the slide) wrapped round the beam had been used previously to tell the user how much gold had come off the guineas, but when the sovereign coins were first minted in 1816, the scale-makers converted the slide to a different function. The sovereign was a little lighter than the guinea, so if a little mass could be added on the coin side of the fulcrum, the sovereign could be checked against the mass that otherwise balanced the guinea. The cypher is the old word for zero, which is marked on the beam near the fulcrum. *The turns for a half sovereign same as a half guinea with the slide at $^{1}/_{2}$ S.* Push the flat brass slide to the groove on the beam marked $^{1}/_{2}$ **S**, put the smaller poise flipped towards the end of the steelyard and the larger poise flipped towards the fulcrum. *The turns for a sovereign same as a guinea with the slide at S.* Put both poises flipped towards the end of the steelyard to give maximum mass, then deduct a little bit by pushing the slide on the other side of the fulcrum to the groove marked **S**. The coin had to "draw" the scale, that is, tip it right down.

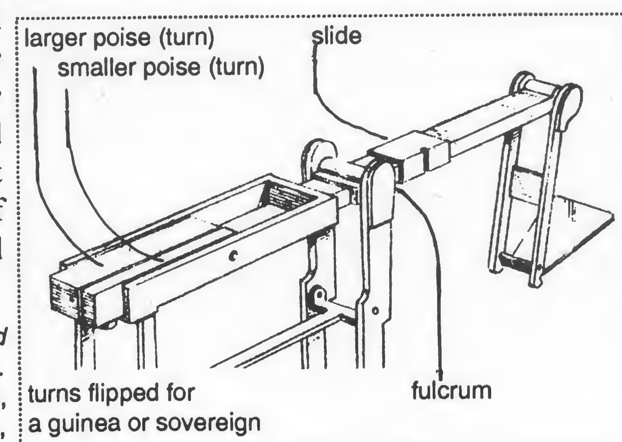


Fig. 1. Sketch from *Weighing Coins, English folding gold balances of the 18th and 19th Centuries* by M A Crawforth. This design was first made by A Wilkinson in Lancashire, c.1798, so presumably Wilkinson's successor, S Houghton, was supplying DeGrave in London after 1816.

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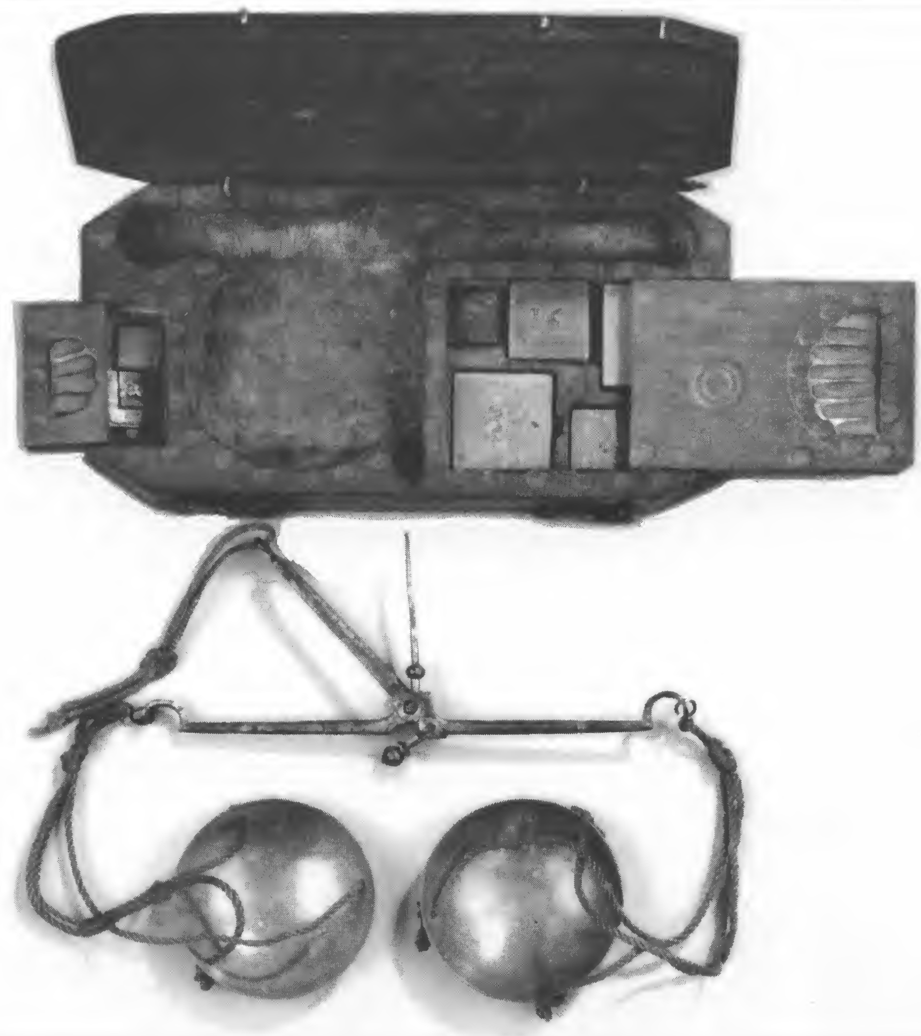

Notes & Queries

N & Q 136	From J COLLINS

I enclose a photograph (Cover) of a diamond scale with SN on parts. Who could have made this set?

N & Q 136	Reply from the editor

Samuel Neale was the son of a blacksmith in Marston Trusell, Northants. He was bound apprentice in London to a scale-maker, Henry Sherman, in 1637, and freed as a fully-trained scale-maker in 1644. Because most of the records of Blacksmiths' Company are lost, it is impossible to assess accurately the influence that he had, but records survive of 7 apprentices he trained, and it is assumed that Henry Neale, another influential scale-maker, was his son or grand-son, using H [hammer crowned] N.

He made coin scales, several of which have survived, (see EQM p 1355-56) and supplied them, with coin weights, to his retail customers, from his shop, the Hammer and Crown in St. Anne's Lane. The coin scales had his mark, S [hammer crowned] N, stamped in the pans and sometimes on the beam, a mark probably taken from the insignia of Blacksmiths' Company, by which Company he was stripped of office because he supported the Parliamentarians during the Civil War.

This set of diamond scales is the earliest set that can be irrefutably said to be 17th century, although two anonymous sets are recognised stylistically as 17th century. The design features lasted until the mid-19th century; the hemispherical pans, square carat weights protected under a wooden inner lid and the chamfered corners to the box. Features previously not known are the tweezers located in clips at the rear of the box and initials stamped on the tweezers. With apple green velvet and roses stamped on the box with the normal curly posies, I date this box as after 1680 and before 1700. Very desirable!

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My Mysterious Scale

BY J WILEY

Practically everything about this price-indicating scale is a puzzle to me, especially the fan-chart mounted horizontally between the pans of what looks like an ordinary trip scale.[1] The scale itself weighs 40 lbs 8 oz, suggesting its use for rather heavy commodities, although the 8-inch pans would seem to limit its capacity. Somewhat surprisingly, the vertical lift of the end of the beam is only ¼ inch.

The scale is pale blue, a colour that might be distinctive to Indiana scale makers,[2] with gold line decoration. A heavy ornamental brass frame around the fan-chart has the monogram **ATCo** at the apex of the fan. See Fig. 2. Every detail is finely crafted, as if intended for use on a counter in full view of the customers, perhaps in a candy shop.

Fig. 1. Anderson Tool Company Computing Scale, made between 1906 and 1912. Robins'-egg blue finish, with brass trim and pans. 20 inches (500mm) across. Weights missing.

The brass plate on the rear of the base is stamped *The Anderson Tool Company, Anderson, Indiana, Pat. Oct. 2, 1906, No 256*. First, I telephoned the company, only to be told by the supervisor that they did not make scales, and that, to the best of his knowledge, they never had. When I mentioned the patent date, he said they had been in business for only thirty years, and he had never heard of another Anderson Tool Company.

Next I contacted an old friend, Esther Dittlinger, who is a past president of the Anderson Historical Society. Their archives document an earlier *Anderson Tool Company* that was in operation from 1902 until 1912.[3] Faded fragments of a company catalogue show a variety of computing scales, but do not include this scale. The firm's name was modified twice, first to *Anderson Tool and Scale Company*, and, by the time they closed in 1912, to the *Anderson Computing Scale Company*,[4] as shown by the sign-board on the apparently empty factory, evidence surviving as a photograph only.[5]

The only scale-related patent taken out on Oct 2, 1906, is Patent No. 832,879, described by the patentee, William F Harris of Detroit Michigan, as an *Indicator for Scales*. His drawing shows a conventional vertical fan-chart, in use with his idea for a fiducial wire as the indicator.[6] The makers of this scale have obviously adapted his mechanism to operate with a horizontal fan-chart. It is not known whether Harris was affiliated with the company.

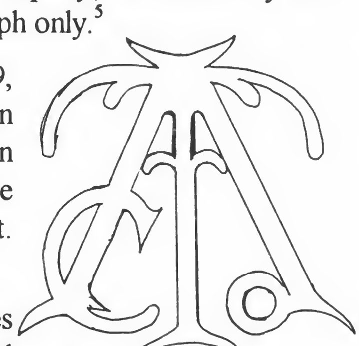
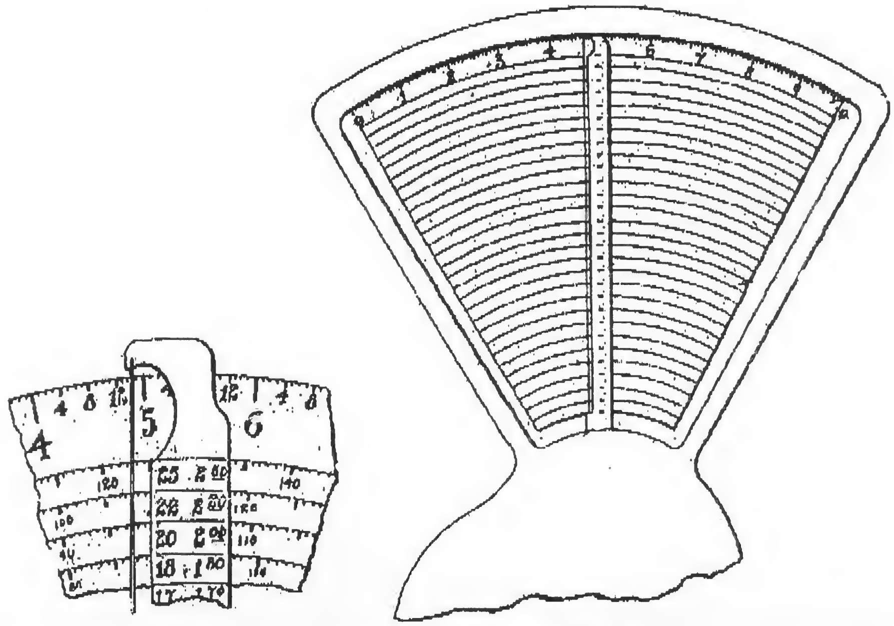


Fig. 2. Monogram on the Anderson Tool Co. scale owned by the author.

The scale is unusual [for an American scale] in having the central knives supported on two separate pillars, one at the front and one at the back, instead of the conventional single pillar bifurcated at the top. The central portion of

Fig. 3. >> W F Harris' patent of Oct 2, 1906, for an Indicator for Scales. The text with the patent shows that Harris was patenting a thread or wire tensioned by a spring, to enable the user to read the numbers on the chart with the minimum obstruction. He was also patenting the means of attaching the spring to the main indicator arm.



the beam consists of one casting, the grid supporting the fan-chart in the middle, and on each side of the grid, a triangular wing divided [bifurcated] to have a knife-edge each side of the housing that protects the vertical rod below the pan. A semi-sphere of solid metal with a well for adjustment is screwed to the bottom of the beam, fig. 4. This appears to function as a damper.[7] Two small bars project from the front beam to provide extra support for the overhanging portion of the fan.[8]

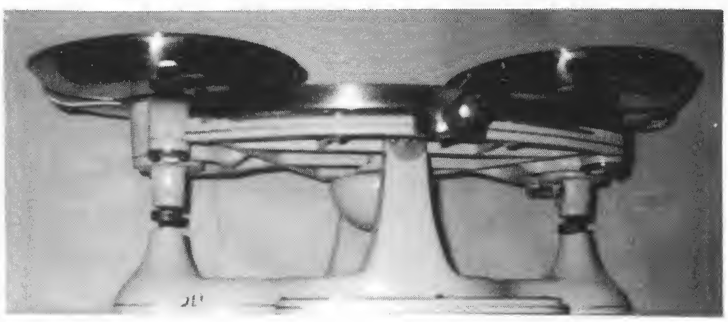


Fig. 4. << Seen from below, the rugged cast-iron framework of the beam/fan-chart shows clearly. The semi-sphere is partly hidden by the central pillar in this view.

The entire chart is integral with the beam and rocks with it. It operates in much the same way as the side-beams often attached to trip-scales, weighing in ounces and their fractions. Three wells for loose weights indicate that the scale could handle quantities up to several pounds avoirdupois.[9]

Fig. 5. >> Tipped onto its back, the integral fan-chart and beam show clearly. Access to the knife-edges is via the screwed-on caps under the bottom of the massive castings under the pans.

Like the fan-charts often seen on candy scales, the computing chart is divided into concentric arcs showing the value of the goods being weighed. But unlike those charts, this one has two arcs, one graduated in Avoirdupois ounces and one graduated in Troy ounces. The outermost arc of the chart is graduated to weigh up to 1 pound Avoirdupois, 16 ounces by $^1/_8$ ounce (54.69 grains). The second arc is graduated to weigh beyond 1 pound Troy (12 Troy ounces) up to 14.6 ounces Troy by $^1/_{10}$ ounce (48 grains). The remaining nineteen arcs on the chart indicate the value of the load being weighed, in dollars and cents per Avoirdupois pound.

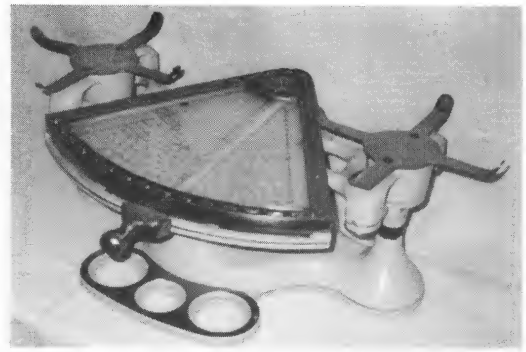


Fig. 6. Showing the wells for weights and the spiders for supporting the pans.

Its two outermost sections are labelled **AVD OZ** and **TROY OZ** and the remaining sections show the prices per pound avoirdupois, ranging from $4.55 (a misprint; it should read $4.50) down to 10 cents. A thin fiducial wire stretched between projections on the two ends of the indicator arm and held taut by a coiled spring at its outer end gives the user a clear view of the figures on both sides of the wire.

The index finger (or indicator arm- Harris uses these terms interchangeably) pivots on a pin at the apex of the fan. The large brass knob on the free end of the indicator arm serves as both the poise and a handle to position the indicator arm. In lieu of the usual notched and graduated metal beam, it slides in a groove between the cast iron base and the brass frame of the chart.

The scale operates exactly like any trip scale having a side beam. To weigh in quantities less than 16 ounces Avoirdupois or 14.6 ounces Troy, move the poise to the extreme left. The chart will be level. When the goods are placed on the left pan, the chart will tilt down with the beam to the left. The poise is moved with the indicator arm to the right until the beam is in equilibrium. It is then possible to read the weight of the article in Avoir or Troy, and read its value (per avoirdupois pound). This is simple as long as the weight of the goods does not exceed the capacity of the chart.

But it gets complicated if equilibrium is not reached at that point. To weigh in larger quantities, use loose weights on the right pan for each whole pound, recording the total value for that number of pounds avoirdupois. Then weigh any fractional amount using the chart and add the value of that amount to the previous total.

The only other known example of this scale, owned by Ted Stein, is slightly older than mine. As shown by the decal on its base, fig. 7, his was made before Oct. 2, 1906, when the patent was issued.

What would such a scale have been used for? Since the troy ounce arc is not divided into drams and scruples, it is obviously not a pharmaceutical scale. According to a 1975 *Americana Encyclopaedia* article, the Troy ounce was sometimes divided decimally[10] for assaying. But a roberval

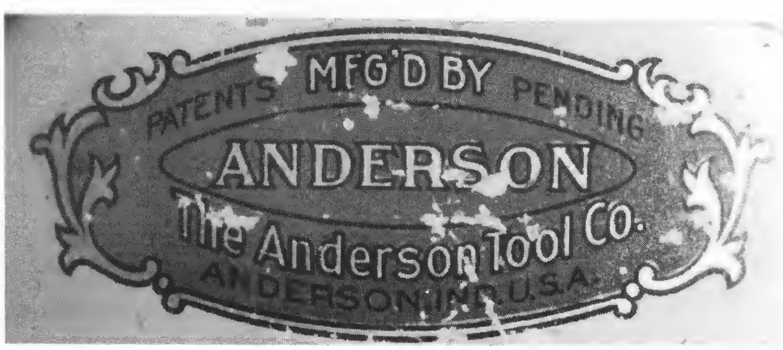


Fig. 7. Decal on the base of Ted Stein's example. The vivid red oval is edged in black with gold infill in the scrolls and in the hollow letters. Very ornamental.

Courtesy T Stein

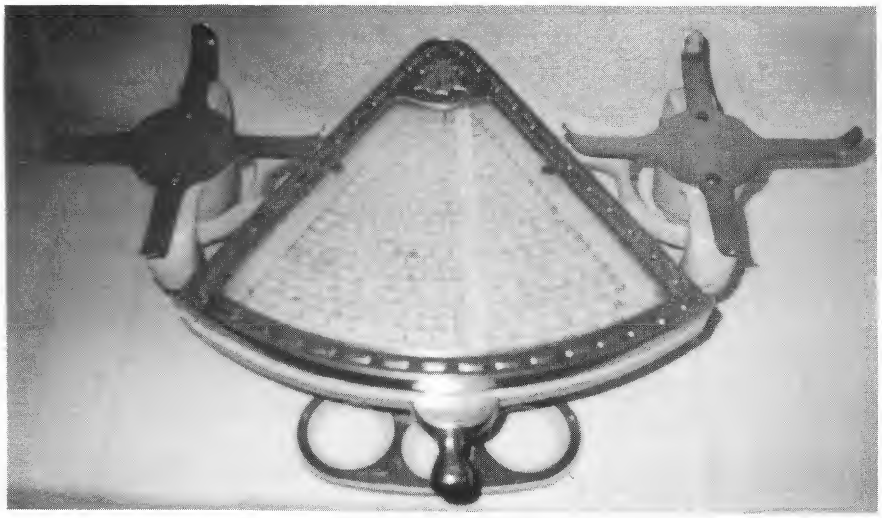


Fig. 8. To assess the asymmetry of the fan-chart, look at the area of the fan behind the screws one-third of the way down the sides of the chart. The screws are fixed to the middle of the beam. Not only is the chart over-hanging the front, but the indicator arm has a heavy poise attached to its front end, adding even more weight to the front.[11]

mechanism is not usually considered sensitive enough for that purpose. What commodity would be weighed in $^1/_8$ ounce avoirdupois increments? As mentioned earlier, the scale is beautifully finished, as if for use in public view. But few shops would also be selling by Troy weight (gems or precious metals). What trade would find it useful? Why is this scale so rare? Can any reader supply this information?

Notes and References

1 Trip scale. An American term for a roberval scale with an accelerating beam.

2 Pale blue computing scales are known to have been made by the Angldile and Strubler scale companies, both of Elkhart IN. (See EQM 2131-2139.)

3 The dates of Anderson Tool Company prove that these scales were for sale at the same time, and in the same State, as Angldile and Strubler scales, with similar capacity.

4 Information supplied by Esther Dittlinger and Harry Hudson of Anderson, IN. The names of early patentees and others active in the company include Corbin, Dunn, William F Harris, and Clem Hoover. Benjamin D Emanuel, an entrepreneur who ultimately bought the company, patented the first American *computing* weighing scoop in 1906. (See EQM 489, 492.)

5 This photograph was kindly supplied by Harry Hudson of Hudson Printing Co.

6 Harris makes no mention of the type of fan to be used, and consequently does not draw attention to the one advantage of the horizontal fan:- the dimunition of the problems of parallax between the fuducial edge and the numbers. Because the user could look down, he got a reasonable view of the wire in relation to the numbers.

7 Editor:- Any comments about the function of this semi-sphere would be welcomed.

8 Editor:- The fan-chart is asymmetrically mounted, with one-fifth of the chart projecting forward and no part projecting backwards. Any comments on the forces applied to the central knives would be welcomed.

9 The weights were probably for 1-lb, 2-lbs and 4-lbs, giving a maximum capacity of 8 lbs Avoir. Can any collector confirm this?

10 In the UK, the 1878 Act of Parliament permitted the use of decimal fractions of Troy ounces but did not make their use compulsory.

11 The photographs were taken by the author.

Author's biography See page 2140

Correction:

Bob Holdaway points out that the Contemporary Comment by Cunliffe and Owen, EQM, p 2209, was published only with the Board of Trade Notices of 1913, but not with those of 1927. Cunliffe died in 1920, before Cunliffe and Owen's project to produce a second volume of annotations could be achieved, the First World War having intervened. Thanks to Bob for this additional information.

Response on Régnier

By Y NOËL

The powder-prover designed by Edme Régnier (EQM, p 2171-2172) was illustrated in his book *Mémoires Explicatifs du Dynamomètre et Autres Machines inventées par le C^{en} Regnier* published in October/November 1798. It was shown in the section *Description et Usage d'un Éprouvette Portative*, and was very much simpler than "rigging up a frame".

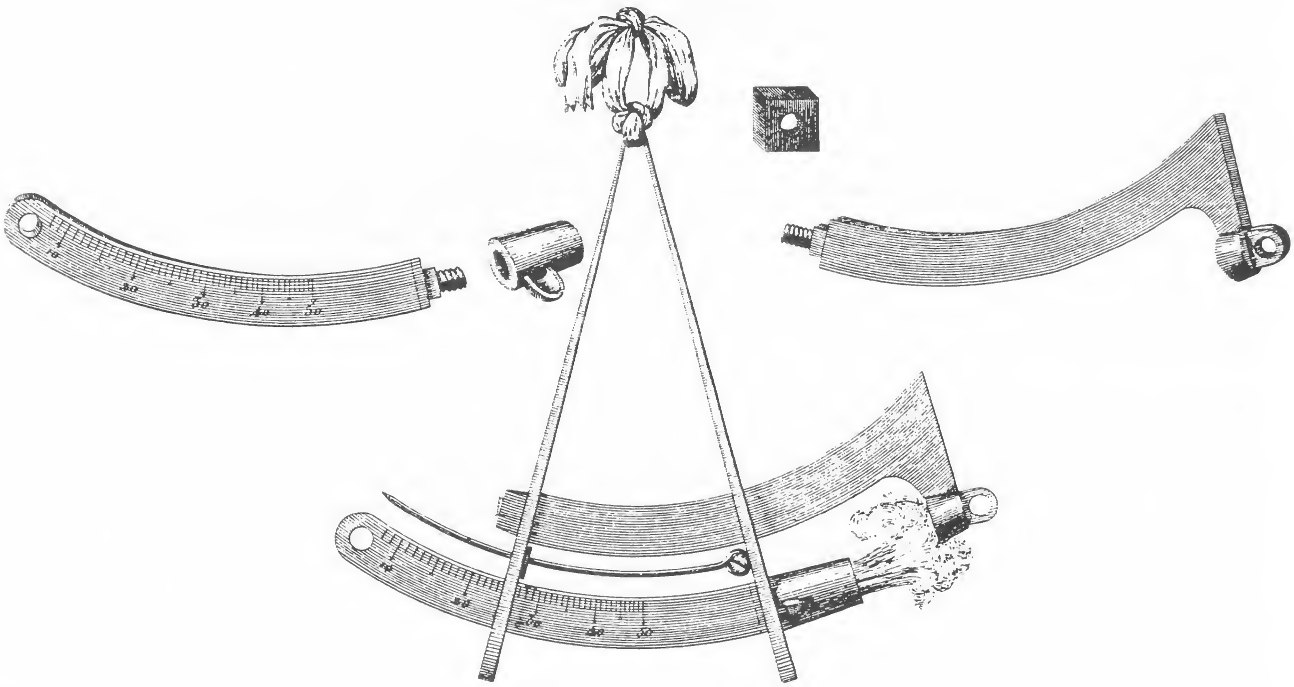
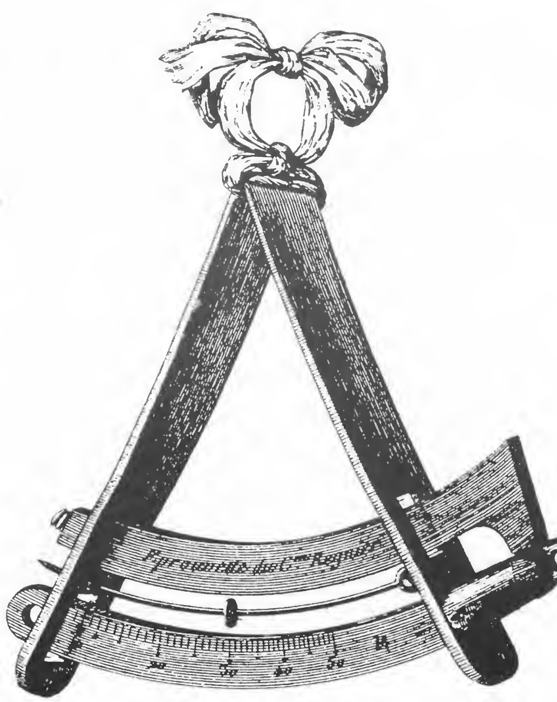


Fig. 1. ⮝⮝ Plate III from Régnier's book.

A copy of the book is held by the Musée des Poudres at Sevran, 12 km to the North-East of Paris.

Fig. 2. ➤➤ The decorative ribbon was probably used to tie the Prover to the belt or bandolier.



As can be seen clearly in the picture, the gunpowder was contained in a substantial cylinder screwed to the lower arc. This adaptation of a standard V-spring scale (still usable if a hook and ring were put into the holes at the extreme ends of the arcs) would have been economical to buy and easily carried by a soldier.

As gunpowder varied in power from batch to batch, this prover would have been very useful to the soldier in determining the distance that the ball would be propelled.

Note that Poggendorff's book, note 2, is *Biographisch Litererisches Handwörterbuch......*Apologies from the editor.

Inventing the Moneyweight Scale

JULIUS E PITRAT'S THOUGHTS, AS SEEN THROUGH HIS PATENTS

Compiled from US Patents provided by B F SMITH

The Remarkable Moneyweight Scale, EQM, p 2199-2208, developed gradually through ten patents. After study of the first four patents that formed the basis of the Moneyweight Scale, Julius E Pitrat can truly be called an inventor of a price-indicating scale, and not merely an improver. It is amazing that Pitrat had no engineering factory to build his inventions and give him the advantage of testing his ideas on scales.

Born in 1817, his first job was as a silk-weaver in France[1], where he probably had experience of the Jacquard loom, that innovative precursor of so many mechanical devices, but his life in America can scarcely have improved his technical training, as he was successively a miller, queensware merchant,[2] grocer, farmer[3] and teacher of French. After he invented his scales he tried to start a scales factory in Gallipolis, but could not raise enough interest, and he sold his patents to the Computing Scale Company in Dayton, Ohio, without retaining any financial stake from which he could benefit when the scales became popular.

314,717. Patented March 31, 1885.

This charmingly idiosyncratic scale was a large counter scale that needed careful manipulation. A collector would put it in the centre of his collection. A trader would mutter while fiddling with it. An Inspector of Weights and Measures would look dubiously at it, wondering how long it would last with all the pulling back and forth. A historian would wonder whether it was ever made.

The fixed parts of the scale were the base with two substantial pillars, the double beam with all the graduations on it, a hanger at the right-hand end of the beam (for money poises) and two TT rests, one at each end of the beam (to prevent the beam from tipping too far). The moveable parts were the pan on its vertical leg, the sliding link set into the base (that kept the leg vertical when moved sideways), the

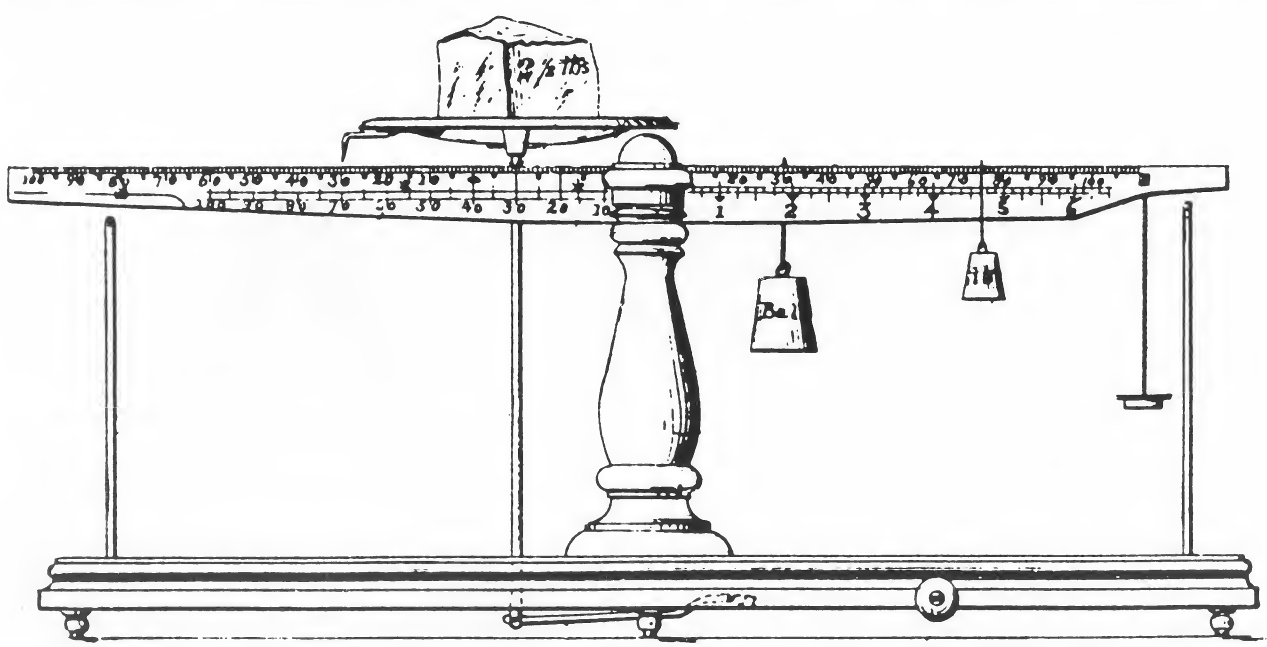


Fig. 1. Pitrat's patent no. 314,717. As shown it is set up to weigh 2½lbs of butter, at 30 cents per pound. The **BAL**-poise is hung on the rear beam and the **LB**-poise is hung on the front beam, but, as both beams are rigidly connected at the ends, they function as one beam.

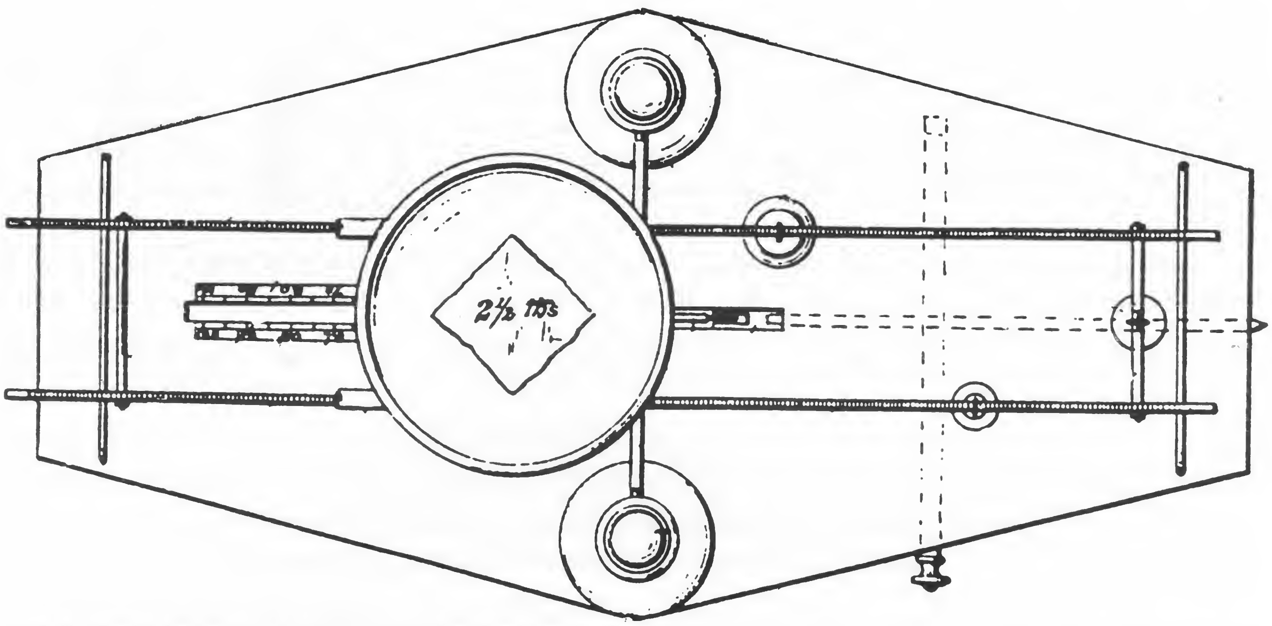


Fig. 2. Pitrat's patent no. 314,717. Top view showing the graduations set into the base. The sliding link, holding the leg vertical, had to read the same number as the top left graduations.

locking pin (that stopped the link from sliding once it was in position) and the various poises.

To use it, the trader looked at the price of the item (say, 30 cents per pound for butter). See fig. 1. He removed the locking-pin at the front right of the base, and lifted the pan up free of the beam and slid it and the vertical leg along to the left until the knib attached to the pan locked into the **30** on the top left graduation. The pan was now resting on two bearings, one on the top of each parallel beam. He checked the graduations set into the base, to make sure that they too read **30**, as that indicated that the vertical leg was truly vertical. See fig. 2. Then he slid the locking-pin back into the base, to prevent any inadvertent sideways travel. The beam was now tipped down on the left, so he put the **Bal** poise onto the right side of the beam at **30** to restore equilibrium.

The trader put the desired 2½-lbs of butter on the pan and slid the **lb** poise (the butter being over a pound in weight) along the right-hand beam. When equilibrium was again achieved, he read off the notch that the **lb** poise was sitting in, that his 2½-lbs of butter cost 75 cents.

Conversely, if the customer asked for 75 cents-worth of butter costing 30 cents per pound, the trader put the pan at **30**, the **Bal** poise at **30** the other side, the **lb** poise at **75** and added butter to the pan until it reached equilibrium.

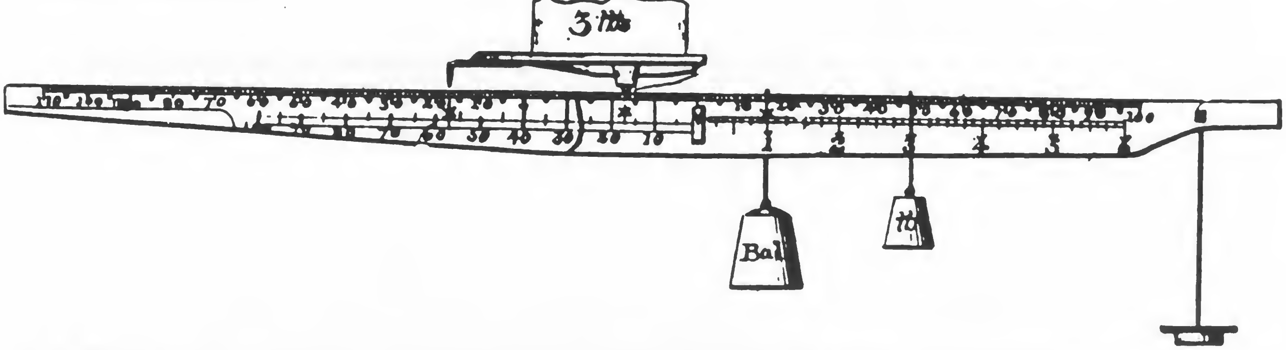


Fig. 3. Pitrat's patent no. 314,717. The beam is shown set up to weigh without pricing. The knife-edges under the pan are on the star, as far to the right as possible, and the knib attached to the pan rests on the star on the upper left graduations. The **Bal**-poise is on its star-mark, (actually in line with the 1-lb weight position), and the **lb**-poise is showing 3-lbs on the bottom right graduations. The maximum load is shown as 6-lbs.

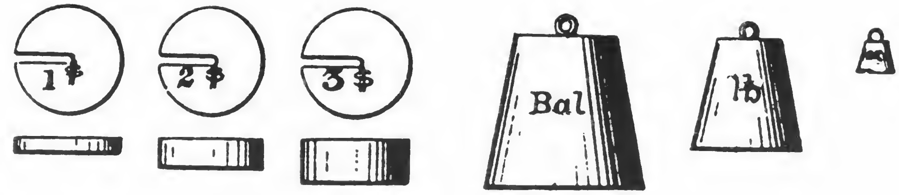


Fig. 4. Pitrat's patent no. 314,717. Three money-poises, the **Bal**-poise, permanently attached to the beam by a loop, and the **lb**- and **oz**-poises which were used alternately as needed.

If the goods had a high value and were sold by the ounce, then the trader used the **oz**-poise instead of the **lb**-poise.

If the price went up over 100 cents, the money-poises were put on the end hanger, adding $1, $2 or $3 to the cost.

When it was desired to find the weight only, the pan was moved to the star, just to the left of the fulcrum, and the **Bal**-poise moved to the right to its star-mark, giving equilibrium, the load was put on the pan and the **oz**- or the **lb**-poise moved along to the right until equilibrium was again found, and the weight was read off as indicated by the latter poise on the lower right graduations. See fig. 3.

So the load was moved away from the fulcrum, and the further away the higher the price per pound (or the price per ounce).

314,166. Patented May 4, 1886.

As patented for a counter scale, it is difficult to see the justification for such an elaborate system of moveable, breakable and loseable bits, when a pointer and dial (invented by another Frenchman and in use for over a hundred years) would have given instant read-out. However, Pitrat pursued his ideas, by coupling his invention to the hanger of a platform scale. This was *THE* innovative idea.

He got rid of the pan (having now the platform for the goods) and he put the whole of his graduated beam and its support pillars on a wheeled base that was moved sideways by grasping the pillar. Pitrat had obviously had second thoughts about which bit of his mechanism the grocer got hold of, to move it laterally. The locking-pin was dispensed with, presumably because the vertical leg was now only an inch or two long, and could be kept vertical by visual inspection. The oz-poise was no longer appropriate on a massive platform scale, so was not included.

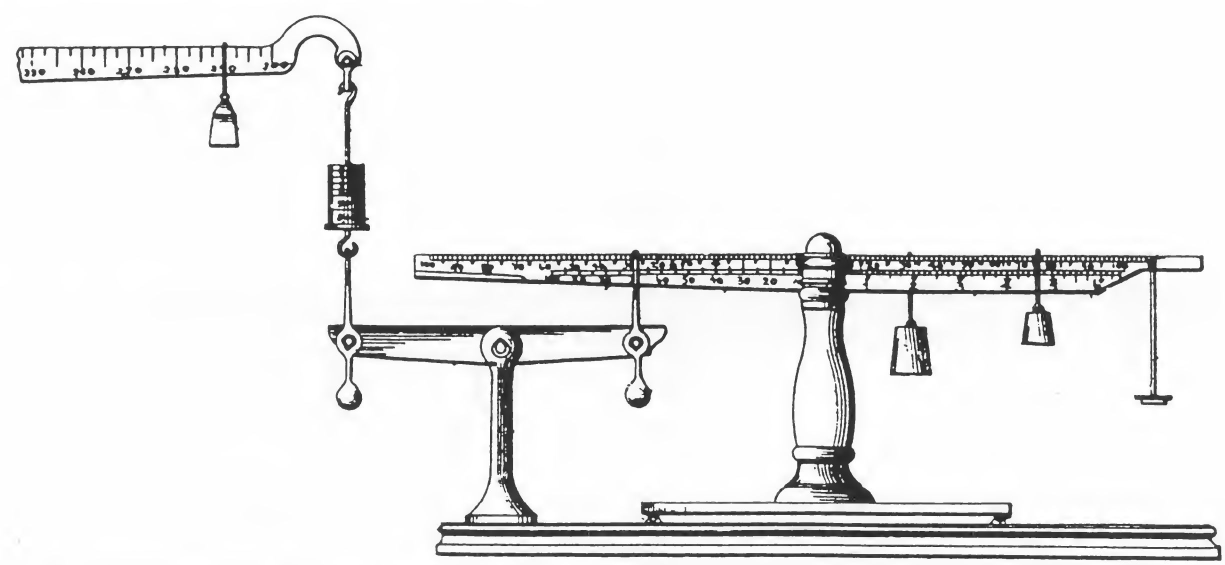


Fig. 5. Pitrat's patent no. 314,166. Pitrat's beam is only double on the right side of the fulcrum. The wheels of the base are just visible under the sub-base. The poises are not labelled **Bal** or **lb** but work in the same way as on his first patent.

To use it, the grocer weighed the goods on the platform scale in the normal way, and left its poises in position on the steelyard indicating the weight. He moved the Pitrat invention on its wheeled base until the link **I** fell into the notch of Pitrat's beam that indicated the price per pound of the goods being priced. Then he moved the **Bal**-poise along the right side of the beam until the beam tipped up, bearing hard enough against the link **I** to maintain it in place. He went back to the platform scale and removed the poises from the steelyard's hanger and pushed the steelyard's rider-poise back to zero. This caused the steelyard of the platform scale to rise and press upwards with a force equal to the downward pressure exerted by the poises before they were removed. Through the levers, the far end of Pitrat's beam also rose. The grocer brought it back to equilibrium by putting the **lb**-poise onto the far end of Pitrat's beam, and he could then read off the price on the top right graduations.

As with Pitrat's earlier invention, the system could be set up with a specific weight and price per pound, and goods added to the platform until equilibrium was achieved.

So in effect, Pitrat's beam and poises temporarily replaced the platform steelyard, and instead of reading off the steelyard in pounds, the grocer could read off Pitrat's upper beam in cents.

356,077. Patented January 11, 1887.
Pitrat did not mention in his 1886 patent that it was essential to position his pricing mechanism very carefully at the correct height and distance from the platform scale to permit the full range of his mechanism to operate. Possibly he went on chewing over this problem until he came up with the next improvement;- positioning his mechanism on top of the platform scale, permanently attached by the manufacturer so that no errors could occur in setting up.

By putting his mechanism to the left of the fulcrum, he eliminated the need for compound levers, but the manufacturer had to extend the beam of the platform-steelyard backwards (to the left) and install a side-arm on the right side of the fulcrum to counterbalance the weight of this extension and the vertical link that rose from it. The grocer could temporarily use Pitrat's beam to register the weight (but read off as a price), in effect by-passing the platform-steelyard.

Pitrat also thought about the type of weighing that was done on a platform scale. Large quantities of cheap products were weighed, that were not quoted in cents per one pound, but instead were quoted in cents per many pounds[4]. He called these many pounds "the Rate". He talked of cents per 60 lbs, (a 60-lbs rate), cents per 32-lbs, (a 32-lbs rate) or cents per 100 pounds, (a 100 lbs rate). He therefore introduced a slide-rule or ratio-bar to allow positioning of his mechanism to suit "the Rate".

To use it, the grocer looked up the price of the product (say, 120-lbs wheat at 90 cents per 60-lbs). He wound the handle at the left end of the platform steelyard until the vertical leg read 60. At this moment, Pitrat's mechanism was tipping the platform steelyard down on the right, so the grocer moved to the right of the fulcrum of the platform-steelyard and screwed the poise (that on his earliest mechanism Pitrat had labelled **Bal**) along the side-arm to its mark of 60, to put the steelyard back into equilibrium. Then he put a tare-poise on the hanger of the platform-steelyard to compensate for the weight of the container. (Although there is no mention of this tare-poise in the patent, it was essential to leave it on the hanger throughout the rest of the procedure, or the container would have been priced as product).

Then the grocer slid the slide-rule along its groove until the zero mark on the slide-rule lined up with the 60 marked in the bottom of the groove. (There is no diagram showing the graduations in this groove, but they are mentioned in the words of the patent.) Then he wound the little handle on the wheeled-base of Pitrat's mechanism until the pointer on the wheeled-base lined up with 90 on the slide-rule.

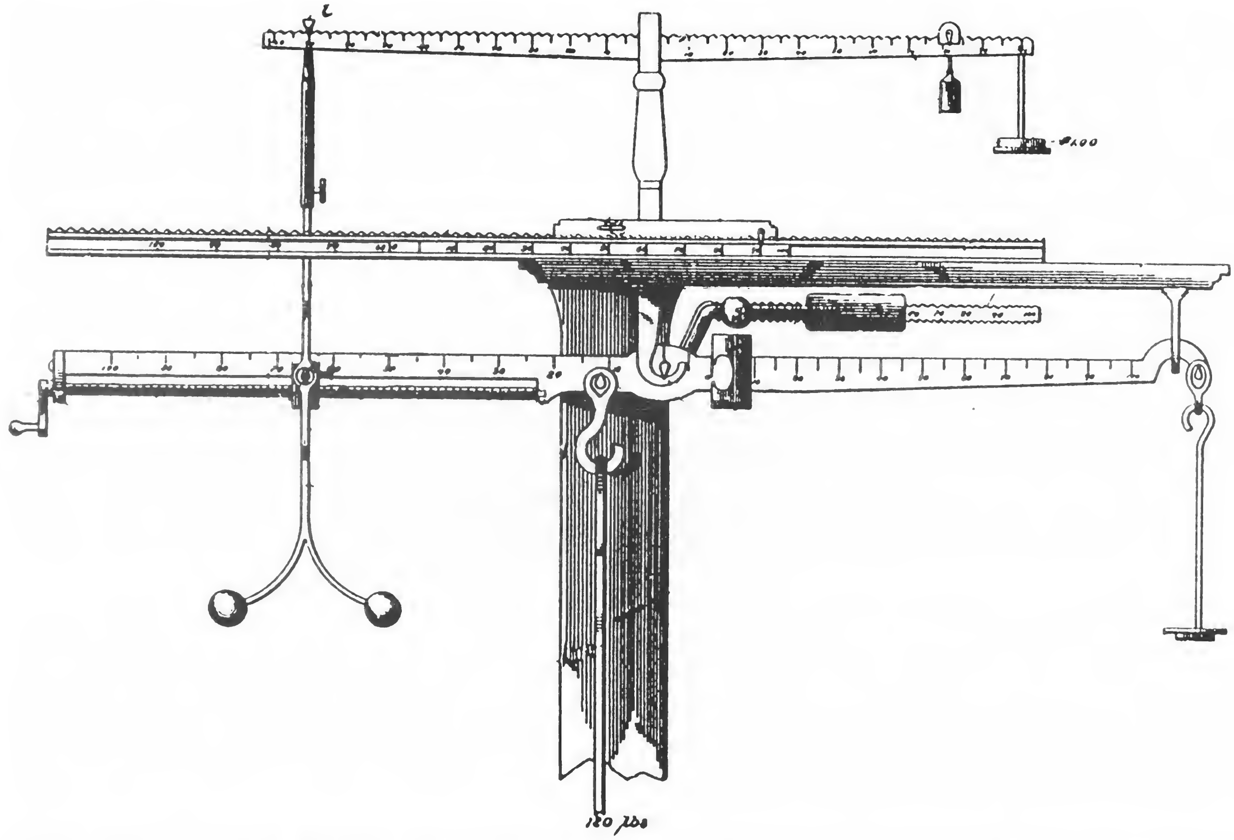


Fig. 6. Pitrat's patent no. 356,077. The two balls are pendulous lumps that keep the leg vertical even when the top of the leg is not connected to Pitrat's beam. As shown the beam is set up to price 120-lbs at 90 cents per 60-lbs, with Pitrat's beam reading the final price of $1.80.

This winding also brought the vertical leg into line with the 90 marked on the left arm of Pitrat's mechanism. When the load of wheat in its container was put on the platform, the steelyard tipped down to the left, dragging down the vertical leg, which engaged in the 90 notch of Pitrat's beam, and tipped down Pitrat's beam. Because the normal poise on the platform-steelyard was still at zero, and no poises were on the hanger of the steelyard (except that elusive tare-poise), the steelyard was in effect circumvented, and the weighing process could be done on Pitrat's beam.

The grocer put on the rider-poise but, even at its position fully to the right, it was not heavy enough to balance that load of 120-lbs, so he put the rider-poise back to zero and added a money-poise on the hanger of Pitrat's beam for $1.00 then tried moving the rider-poise again. It tipped into equilibrium when the rider-poise was at 80 on the right side of the beam, and the price of $1.80 was found.

As with his previous inventions, all could be set up without a load, including the price that was to be paid, and then the product was poured into the container until equilibrium was achieved.

If the platform scale was needed for weighing only, Pitrat's mechanism could be detached by loosening the vertical link using the turn-key near its top, thus slackening the link so that no pressure was exerted on Pitrat's beam, and noting the reading of the vertical link on the left side of the fulcrum of the steelyard. Say it read 27, then the **Bal**-poise had to be at 27 also, on the other side of the fulcrum, to neutralise the extension on the left. The grocer could then use the platform scale in the normal way.

The grocer had so many operations that he probably had a routine to return the whole system to zero between each weighing. How a cynical customer kept an eye on the grocer is difficult to imagine, as it

is hard to envisage the customer understanding the principles being applied. The grocer might easily set the **Bal**-poise a little nearer the fulcrum than he should and who would notice?

385,005. June 26, 1888.

This fourth design went back to indicating the price in cents per pound, eliminating the need for the slide-rule and simplifying the routine followed by the grocer. By combining the steelyard of the platform scale with his mechanism, only one beam was needed and an elegant solution was provided. Why didn't the Computing Scale Co. manufacture this arrangement? [They retained Pitrat's third patent.]

Pitrat commented in this patent, "*Weighing and pricing scales as generally constructed are comparatively heavier than weighing scales simply of corresponding size and capacity, owing to the additional beams and weights. Now these additional beams and weights impose an unnecessary load upon the platform levers.*" This sounds as if there were many variations of these computing scales on the market in 1887 [when the patent was written] but little is recorded about them. Can any members confirm that there were many? The comment also reflects Pitrat's adaptable brain. His third patent was heavy, so his fourth patent solved that problem.

Pitrat went on to think about the sub-linkage YV under the platform, and added a simple lever with a metal cylinder on its end, to counteract the mass of the compound levers, the platform, the container and the cross-head block. This meant that the leverage applied would be much less than on an ordinary platform scale, and lighter poises would be sufficient to bring the steelyard back into equilibrium.[5]

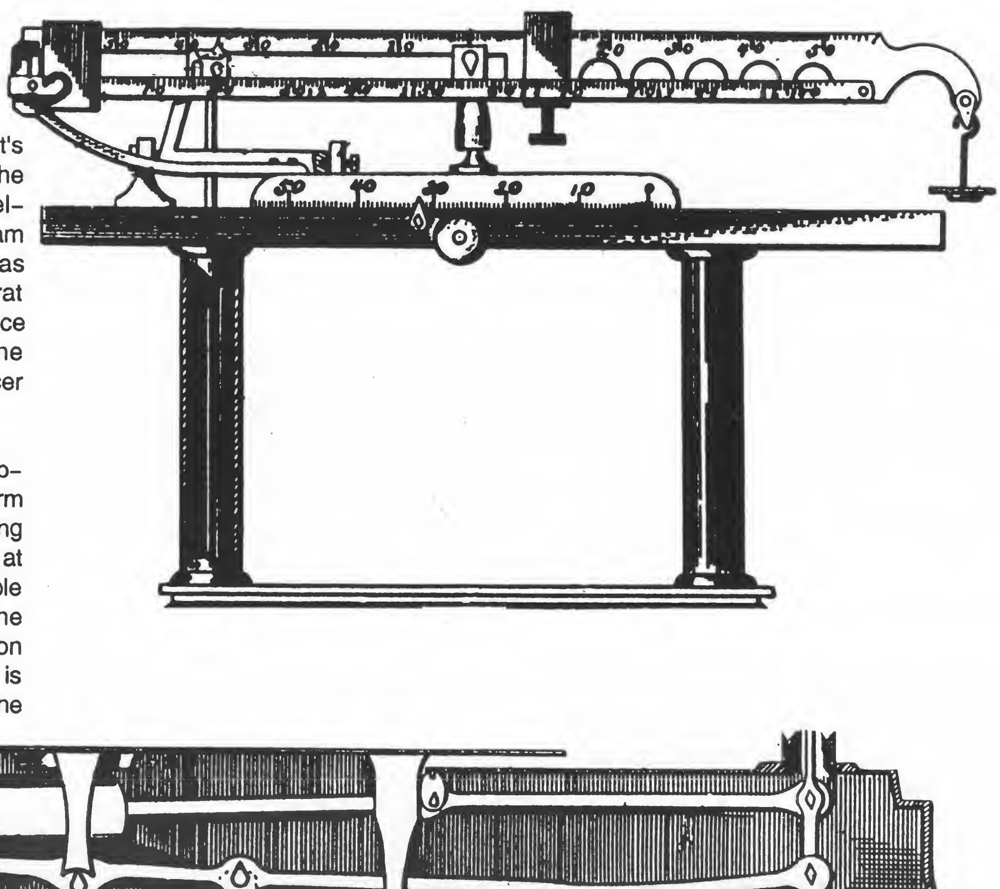
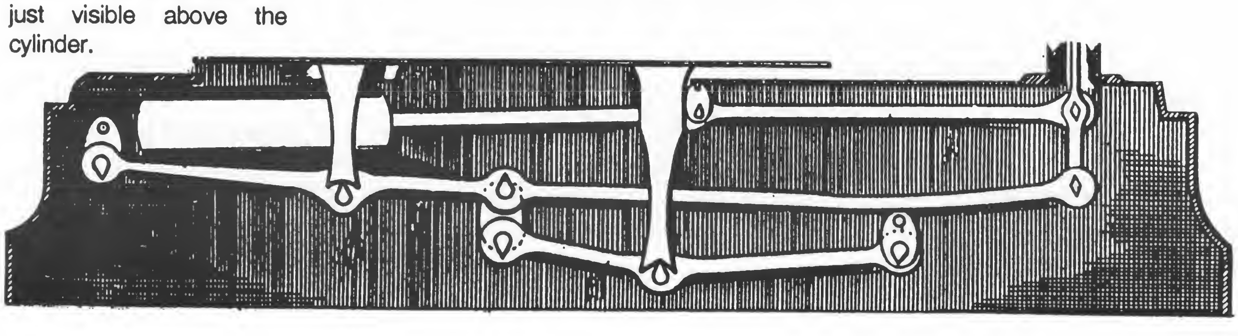


Fig. 7. ➢➢ Pitrat's patent no. 385,005. The combination of the steelyard and Pitrat's beam looks workable, yet it was not manufactured. Pitrat included a locking device to stop wear on the knives as the grocer moved the parts.

Fig. 8 ∨∨ The sub-linkage under the platform of patent 385,005, showing the compound levers at the bottom, and the simple lever just under the platform. The depression to take the tare-poise is just visible above the cylinder.



He had also thought about the need for a tare-poise, and devised a simple solution whereby the container fitted into a hole in the platform, so, when the container was not required, the grocer filled the hole with a neatly fitting disc of the same weight as the container, (Fig. 8). Thus the scale was adjusted to take the weight of the container at all times. Again, elegant.

Notes and References

1 Our thanks to the Gallipolis Family History Society for the newspaper cuttings relating to the life and death of Pitrat.

2 Queen's ware was a high quality ceramic tableware of cream finish, originally invented by Josiah Wedgwood.

3 While a farmer, Pitrat fell with a horse and damaged his back severely. He had to give up farming, return to the city of Gallipolis, and find less strenuous ways to earn money to support his family of eight children.

4 Pitrat talked of bushels of 60-lbs, 32-lbs or other weights. Was this method of defining a bushel by weight a memory of his life in France? Our ISASC member Jack Young has memories of meat *only* being weighed on Computing Scales, and dry goods such as vegetables, sugar, flour, etc., being sold by their bulk. It is conceivable that Pitrat was attempting to change the habits of his new country, while introducing his new concept in weighing, or possibly grocers used different ways of defining a bushel of flour (by capacity or by weight) in different parts of the USA. Can any member help us to record the methods used by grocers in USA?

5 Cheeseman, J, private communication. John explained the principles behind the patent. It is interesting that Pitrat was the first to add the simple lever to the connecting rod, and could take out a patent for this basic idea.

Editor- In Britain, very few dry goods were sold by capacity measure in living memory. Grass seed, mushy peas and small shell-fish came by the half-pint or the gill, but items like flour and sugar were sold by weight.

Remembering the Worst

BY C SAIT

I have often thought that a competition to find the worst set of scales would prove interesting. There is an example in my loft that would stand a good chance of winning. At least, I thought that until last Wednesday while my wife and I were on a touring holiday.

There were two sets of scales identical as far as the extremely poor workmanship would allow. The 12-inch (300mm) long, rough wooden base looked like a piece of floorboard into which had been gouged a hole to take the upright pillar. This, about 10 inches (250mm) high and made of badly-finished packing-box wood, held an equally rough crossbeam at the ends of which dangled two roughly hand-beaten pans made from food-cans. Who would degrade themselves to use such inaccurate monstrosities? They looked as if they had been hastily made by young children keen to get out to play, not for food.

Their age is fairly well documented at about 60 years old. In use they would have been overseen by officers as if life and death depended on how well the scales were operated. Perhaps unbelievably, they are seen by thousands of people, young and old, every year. They are well-preserved in toughened glass display cases and the whole place is patrolled by observant, helpful staff.

Considering the fact that my wife and I had made a special detour to visit the place, it would be reasonable to ask if it was a bit of a joke. It was actually the museum of the Buchenwald Concentration Camp.

Author's Biography

Charles Sait, now retired, used to visit East Germany and Poland extensively on business. It was during the long weekends under the old Communist regime that he started visiting concentration camps. He sums up his reasons quite simply. Many people suffered and died at these places and had no-one to remember them. If in some infinitesimally small way he can compensate for that, he vowed he would do so. He never took a guided tour, never got involved in the politics or emotions but just simply remembered.

He has taken his wife to several since those days while touring on the continent. They walk round, usually separately, quietly and reverently and rarely discuss it afterwards.

Review

Die Waage des Chemikers, The Chemist's Balance. By Hans R Jenemann. Pp 87, 66 illus. DECHEMA and H R Jenemann-Stiftung: Frankfurt. 1997. DM 30. ISBN 3-926959-71-1.

Hans R Jenemann, 1920-1996, was an analytical chemist who was also an enthusiastic collector of chemical balances and ISASC member. He researched, published and lectured extensively on their design and development. Towards the end of his life the bulk of his collection was transferred to Mettler-Toledo in Gießen and a trust established for work on the History of Scientific Instruments.

Die Waage des Chemikers; The Chemist's Balance, is Jenemann's final published work on balances, being a revised version of an extended paper with an exhibition of 1979, with parallel text in German and English (superbly translated). His account of the evolution of fine weighing from earliest times to the late 1970s is abundantly illustrated with balances showing major changes, such as the gradual introduction of arrestment, and the hunt for wear-resistant materials for planes and knives. Such an account could have been a mere list of changes, many of them imperceptible or of only slight benefit to the user. Jenemann, however, goes deeply into the development against its historical background, noting the changes in industry, commerce, science and politics. The influence of the user in determining the direction and rate of change in design is emphasised, and the achievements of individual makers are discussed comprehensively.

There is an extensive (mainly German) bibliography covering both primary and secondary sources, but, alas, no index to help locate the many important makers, users and innovators, whose work is so carefully analysed.

Jenemann amassing a wide and varied collection of analytical and precision balances, mainly of German origin, at a time when many were being discarded and he was justly proud of the excellent photographs he took of them, many of which were used to illustrate this book. As German balances are under-represented in English collections, this book gives a useful insight into techniques and influences that might be overlooked.

Balance-design has always had an international dimension as each idea was adopted, modified, "improved upon", "borrowed" and built-upon by others. This book illustrates this well, in a scholarly fashion, but couched in terms easily understood by the layman. It is clearly written and well translated, of value to many historians of science and scientific-instrument making, supplying as it does a wide picture of the advancing skills which in turn promoted ever-finer standards of weighing. P Buchanan

Paul Bunge Prize

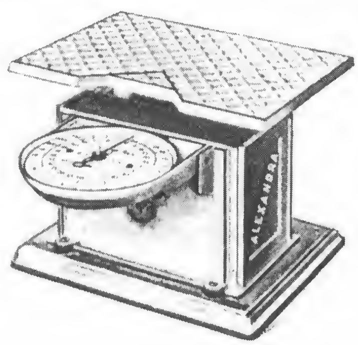
The prize awarded by the Hans Jenemann Foundation was awarded in 1998 to Dr. Robert Bud of the Science Museum, London, and Deborah Jean Warner, of the Smithsonian Institution, Washington, [editor of *Rittenhouse*, the journal on American Scientific Instruments], in recognition of their jointly editing the encyclopedia *Instruments of Science*, (New York and London, 1998). With this work, both scientists have given this young research field a leading standard work with which the historical research on instruments, as a whole, will be decisively promoted.

Editor:- A decision will be made shortly as to whether a review of this book will be prepared for EQM. The editor contributed an entry on weighing to *Instruments of Science*.

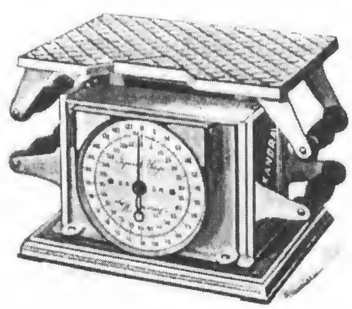
Alexandra Person & Package Scale

A response by M DANELL and R HILL

The Cover Picture on EQM, page 2169 showed a repainted Person scale, luggage scale and dynamometer combined. Under the paint was the vital clue, painted obliquely across the side panels, "ALEXANDRA". This was the trade name registered in 1906 by A von der Nahmer of the Alexanderwerk, Remscheid. In the 1913 catalogue, there is this comment (translated by Roger Hill):-



In the widest of circles and particularly with doctors, sportsmen and the like, **Alexandra** personal weighing machines and luggage scales have met with the most enthusiastic reception. Everyone finds it of interest to maintain a constant check on their weight, while for children, those who are sick and on the road to recovery, it is positively recommended. However, **Alexandra** scales also perform a useful service when it comes to checking the weight of goods you have bought, as well as for weighing luggage and so forth. The outstanding design of **Alexandra** products ensures accurate weighing every time; the indicator needle, protected against damage by a glass shield, can be set precisely at any time using the adjustment system.

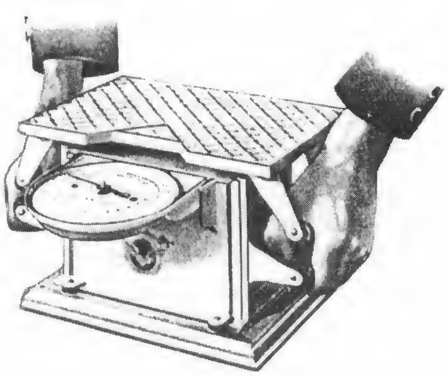


The device is made of iron throughout, carefully painted and finished with an elegant sheen, with gold-bronze decoration. The indicator dial is white enamelled. The **Alexandra** weighs approximately 10 kg and is about the same size as a footstool. It can therefore be placed anywhere and used at any time with ease. It will weigh up to 125 kg.

When the **Alexandra** is used as a personal weighing machine, the dial is swivelled into the horizontal position. When used for weighing luggage, the dial remains vertical. In either circumstances it is easy to read the weight which is displayed.

If desired, the **Alexandra** can also be equipped with a very practical muscle strength meter. The illustration below shows how this is used.

Retail price: M 18-- With muscle strength meter: M 20--

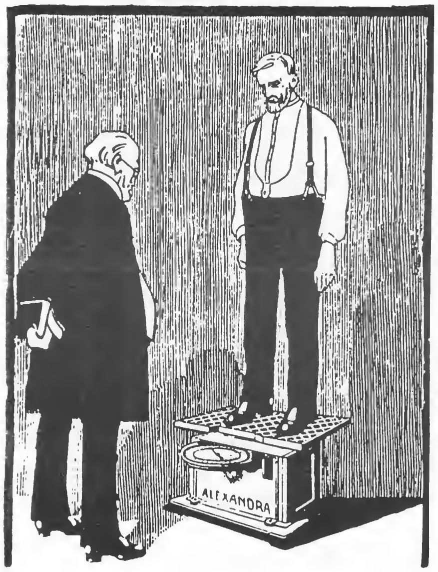


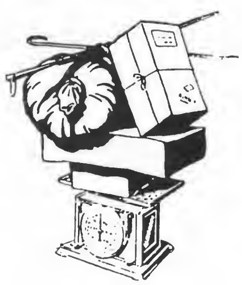
With every Alexandra weighing machine we give a poster, approx. 26 x 20 cm, and printed on fine art card, which can be hung near the machine and gives the table of normal weights for men, women and children.

A von der Nahmer registered two trade-marks in 1898, no. 31949 in August, and no. 32357 in September, for use on his steel, iron and metalwork (fig. 4). His 1913 catalogue shows products for household use, particularly scales, mincers, slicers, presses, steak-hammers and grinders. The most interesting item is the Duplex, two scales facing in opposite directions within one casing, with one pan that could be moved from the heavier capacity scale of 12 kg to the lighter of 2 kg.

A von der Nahmer had a commercial arrangement with G Salter of Britain, by which von der Nahmer sold Salter's top-pan household scales, very much the equivalent of their own household scales, but at a much higher price than their own products. It is difficult to imagine that anyone would pay M 8.75, when he could get a scale to do the same job for between M 2.55 and M 7.00 each. The Salter straight-faced pocket balances, graduated in kilos and German pounds, were a more reasonable M 4.50 to M 27.90 per dozen.

Fig. 4. These drawings were in the catalogue of 1913, apparently to demonstrate the use of the Alexandra, and to entertain the reader.





Trade mark, 1898

Figures 5-13. A von der Nahmer made the most delightful range of top-pan household spring balances. It is difficult to show a typical range of their designs because they varied so much. Dials were graduated in Austrian, English, Russian, Spanish, Greek, Swedish, or Danish pounds, or in Netherlands pounds and kattis (for the Dutch East Indies).

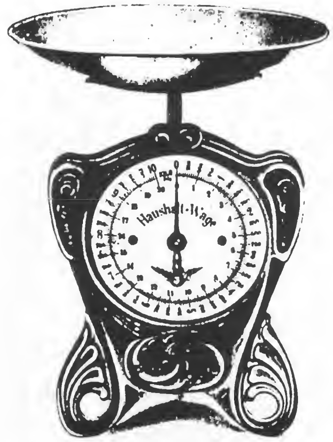


Fig. 5. Nr. 920, blue and green with gold-bronze details. 0-10 kilo & 20 lbs. Classic art-nouveau.

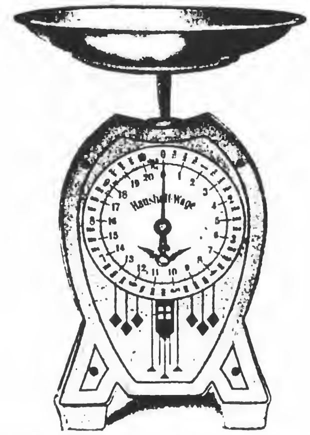


Fig. 6. Nr. 925. Cube-pattern blue and white, best scale for export. Design now called art-deco, but pre-dates art-deco by 20 years.

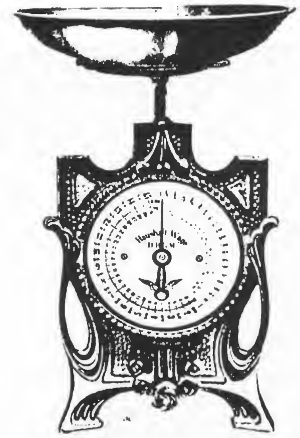


Fig. 7. Nr. 936F. Blue, green and gold. For fine and crude weighing. 0-1 kilo over 2/5 of the dial, & 1-10 kilo over 3/5 of the dial.

Fig. 8. Nr. 1026 for fine and crude weighing. Grey & white, white & gold or olive & copper-bronze.

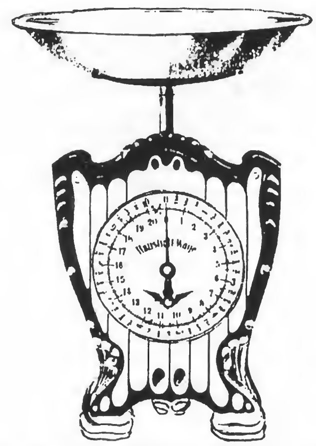


Fig. 9. Nr. 990. Blue striped design. Available with capacity 10 or 15 kilo.

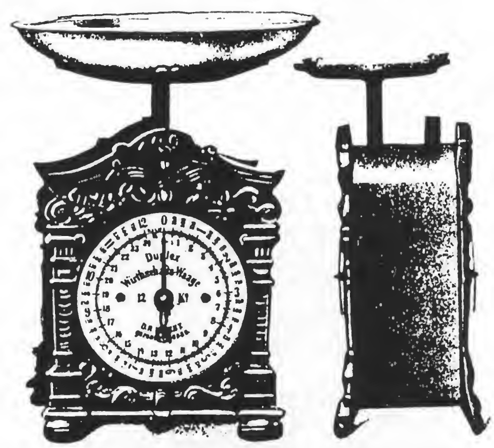


Fig. 10. Nr. 1005. Duplex, 2 scales in one case, 1 side, capacity 2 kilo, and the other side 12 kilo. 2 shafts for the pan. 2 springs each side.

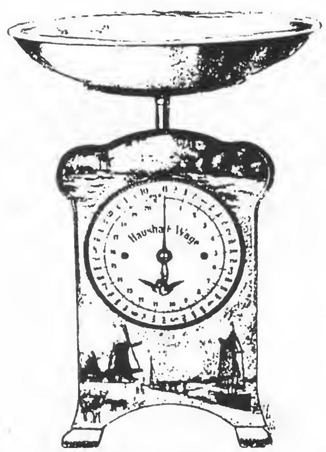


Fig. 11. Nr. 1000. Delft design. Two faces, one fine, one crude as fig. 10. Also available with chrysanthemums.

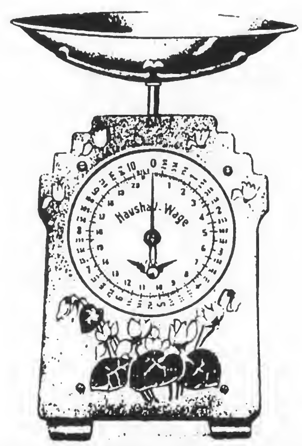


Fig. 12. Nr. 998, cyclamen design. Sheet-metal or cast casing available.

Fig. 13. Nr. 955, swan design. Various pretty designs available on sheet or cast casing.

Review

Antique Weights, The Nineteenth Century, by Norman Biggs. The English Weights Series, White House Publications, Egham, 1998, ISBN 1 8983 10 04 1. 82 pages, 76 illustrations of weights (with a separate price and rarity guide to them), 15 close-ups of marks (and numerous clear marks on the complete weights) and 7 tables. Available from the author, White House, Tite Hill, Englefield Green, Egham, Surrey, TW20 0NJ. Price £7.50 plus 50p for P & P (UK). Discounts available for quantity.

This period incorporates very neatly the huge changes made between the 18th-century concept of local control with local knowledge of fraudulent trading, and the concept of national control with exact regulations to be followed throughout the country. It covers the fascinating changes from bronze and lead through the glorious flowering of designs in cast iron, to the metric system and aluminium weights.

Professor Biggs has, with his customary clarity, taken five chapters to cover (1) Imperial Standards, (2) brass weights, (3) iron weights, (4) invention and protection, and (5) legislation. Without resorting too frequently to caveats, he gives the general picture of weight-making, industrial processes and uses for weights, so that any historian gains a rich impression of the 19th-century situation, any researcher can progress via his thorough references to further work, and any collector can place his weights in context.

Nobody has written briefly and comprehensively on the 19th century weight situation before, but Biggs enables us to have an encapsulation of the British evolution of weights for trade, coin, apothecary and postal use. This volume will be as frequently used as Biggs' previous books, with delight and satisfaction. Thoroughly recommended.

D F C-H

Any Advance on Six?

BY P BUCHANAN

"***I therefore determined to employ wood, a material in which the requisites I sought were combined***".[1] The decision by Henry Kater[2] to use wood for the beam of his new large balance was a move away from the traditional heavy cast-iron to mahogany, a wood popular with furniture-makers for its strength and resistance to warping. On page 2081 of EQM there was a photograph of the smallest of the three surviving mahogany-beamed balances (repeated here as fig. 1). Its beam is only 20 inches (565mm) from knife to knife and about 8 ins (200mm) wide at its centre tapering towards the ends.[3] It is not signed, but stylistically can be attributed to R B Bate, who made Kater's balances for him.[4] This will be called "Bate no. 1", for the purposes of this article. [The caption on page 2081 incorrectly states that it is 48-ins long.]

There is a larger balance with a mahogany beam signed by R B Bate.[5] This beam is made from timber 48 inches (1200mm) long, 1¾ ins thick in the centre.[6] There are 3-inch (75mm) long steel knives and planes, the planes guided on the knives and located by large brass horn-pieces bolted to the arrestment frame. This balance was used in the Bullion Office of the Bank of England to weigh silver bars of 50 to 80 lbs Troy (18.600-29.760 kg) so was designed to take the equivalent of 66 lbs Avoir in each pan without flexing. See Fig. 2a and 2b, "Bate no. 2".

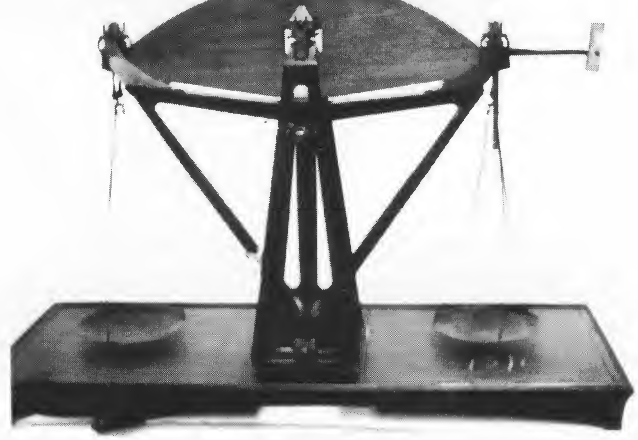
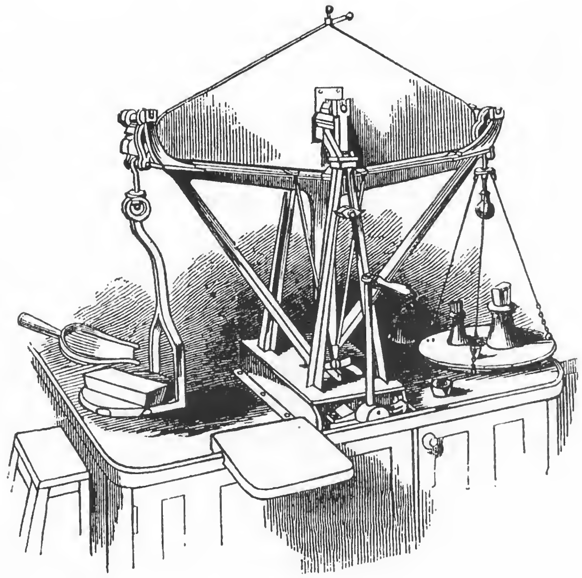


Fig 1. R B Bate, beam 21 ins (525mm).

Fig. 2a. Balance for silver bars, used in the Receiving Office of the Bullion Office of the Bank of England. Bate no. 2. Anybody could send bullion to the Bank, where it was always weighed upon receipt for a small fee, then deposited [stored], sold to the Bank, or sent on to the Mint.

From Illustrated London News, 8 March 1845



The picture in fig. 2a came from an article about the Bank of England written in 1845, which article also shows another bullion balance by Bate which will be referred to as "Bate no. 3". See fig. 3. Bate no. 3 had similar capacity to the 48-ins beam above, being to weigh dollars up to 72-lbs 2oz Troy. Instead of having the arrestment frame curved under the beam, with horns attached to the corners of the frame going up to the knives, the arrestment frame went straight across from one knife to the other, with one brace on each side of the beam. This design of arrestment frame was used on Kater's first design, for the 72-ins beam, discussed below. As can be seen in the drawing of the man using the Bate no. 3, the beam is large compared with the man, and appears to be similar in length to the 48-ins beam shown on the right side of the room. See Fig. 5. This balance's whereabouts is not known.

A photograph, Fig. 4, shows yet another very similar balance, (Bate no. 4) of apparently similar capacity, for 1000-oz (Troy?), which at first glance, is the one designated "Bate no. 2". The shape of the beam is the same, the arrestment frame is the same, and both sit on a little box containing the lifting mechanism (the box is let into the table). The pans have been changed, not surprisingly, when the balance had such a long working life, and the balance-ball over the beam has been changed, but again, that is an insignificant change. The only important feature which looks different is the design of the top of the A frame. In "Bate no. 2" it finishes level with the bottom of the beam, and in this one, it finishes near the centre of the beam. This discrepancy could be due to artistic license on the part of the artist for the *Illustrated London News* or to modernisation during its later working life.

Fig. 2b. The 48-ins beam balance signed by R B Bate, now held in store by the Science Museum, London. As is obvious, great difficulties were encountered in attempting to photograph this large object. B J Oliver remains in shot to demonstrate the size. Note that the flat plate (shown in 2a) has been replaced by a coin scoop.

Fig. 3a. ➢ Balance for dollars. Spanish dollars were brought to the Bank in barrel-loads, and sorted into 21 lbs parcels. Brazilian, Peruvian, Bolivian and US dollars were also purchased. Some were found to be plugged with spurious metal or were made of pewter cased with silver-leaf, so they were checked carefully. From Illustrated London News, 8 March 1845

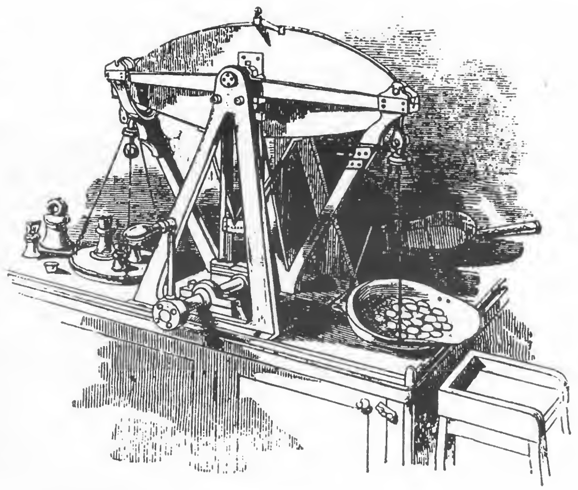


Fig. 3b. The very left-hand dollar weight in Fig. 3a is identical with a surviving example engraved 20 DOLLARS on the handle, and weighing 8320 grains.[7] It bears no Exchequer marks. Photo D Hitchins

Bate made several bullion balances of this design for different customers, only two of which are known to survive. Bate was sufficiently proud of these beams to refer to them in the trade-card (page 2247) of 1838.[8]

Bate was a very successful manufacturer (working 1807 to 1847) and his reputation brought him these prestigious customers. Bate's importance in the field of making rugged but accurate balances stemmed from his early involvement with Kater and Kater's need for incredibly accurate balances.

Dr. Anita McConnell found specific references to one of the beams, in a letter written by Bate to G B Airy[9] in 1842. Bate referred to a beam he had just made for the Honourable East India Co, to take 300-lbs in each pan. It is assumed that Bate remembered the beam he made for Kater seventeen years earlier, in 1825, of the same capacity, and made a similar mahogany-beamed monster with a beam 72 inches (1800mm) long, mounted on an A frame above the user's head. The whereabouts of this "Bate no. 5" is not known.

The renowned Kater 72-ins beam made by Bate[10] was not a bullion balance; it was a balance originally designed to make exceedingly precise comparisons, so was an experimental-scientific balance.[11]

Fig. 4. ➢➢ 1000 oz wooden beam. [83 lbs Troy]. No signature is visible. The pans are a later addition, as is the arrestment mechanism. The lens to the left of the pillar was moved in front of the graduations, to enable the user to read them from a distance (and thus not heat up one side of the metal parts or create a draught.)

Photo Avery Historical Museum

Fig. 5. The Receiving Office of the Bullion Office, in a semi-basement of the Bank of England. Three interconnected rooms included this room, (to which merchants, captains and traders came), a vault (for the public to keep their deposits), and a vault (for the storage of bullion belonging to the Bank). The trolley in the middle foreground was loaded with many 16-lbs bars of gold. The trolley on the right had three boxes of dollars on it. Behind the heels of the man on the left were some ingots of 'Plata Pena' silver, partly-refined lumps of silver containing some mercury (residue from the crude refining done in South America) and a lot of water that had to be evaporated off before weighing. The balance in the middle was used to weigh gold bars, beam about 30 ins (750mm), capacity 18 lbs Troy, designed by Sir John Barton in 1820 and made by Maudslay & Co. (Science Museum, acqu. no. 1933.635.) From the Illustrated London News, 8 March 1845

Fig. 6. ≫ Part of the trade-card printed by R B Bate in 1838.[8] See page 2250 for more evidence relating to inspectors' use of these wooden beams.

R B Bate has also had the honour of constructing Balances for the Bank of England, the three East India Presidencies, and various other public Bodies and Individuals on a new and approved principle; suited for Scientific Experiments, the verification of Weights under the jurisdiction of Inspectors of Local Districts and Counties, or any other purpose requiring extreme accuracy.

"Bate no. 6" was the first of these wooden beams to be designed by Kater and delivered to his house in March, 1825. Kater urgently needed a balance rigid enough to take 300-lbs in each pan, and yet still show minute differences in weight. Not only was it incredibly sensitive, but it also had to remain accurate after being moved by horse and cart back to Bate's premises in April, 1825, so that the Gallon measures could be adjusted there.[12]

The 300-lbs load Kater wished to check comprised the Standard Bushel (a much sturdier bushel measure than a normal bronze bushel measure), its load of distilled water, and sometimes some extra grain weights (compensating for changes in temperature and barometric pressure; if the temperature was one degree off 62°F, another 30 grains had to be added.[14]) As the final reading might be required to register differences of less than a ¼ of one grain, the accurate compensation for temperature and pressure was crucial.

Fig. 7. The 72 ins balance, in working condition at Old Palace Yard, the building used by the Board of Trade because it was relatively free from vibrations and maintained a constant temperature in the Basement..[13] Museum of London

Kater had a refinement built into this 72-ins design; an extra set of little pans mounted between the rods holding the big pans, allowing him to place the weights relating to the difference between each weighing-experiment on the little pans (without getting them muddled up with the compensating weights).

This 72-ins beam, (68-ins knife to knife) proved to be immensely useful to the Board of Trade when they obtained it. They had it rebuilt in 1867[15] by Ludwig Oertling, who retained the original beam and four pans,[16] and the Board of Trade continued to use the rebuilt balance for standards' work until 1959/60[17] - a working life of 135 years, not bad for a material thought by scale-makers to be inferior to metal!

Notes and References

1 Kater, H, & Lardner D, *The Cabinet Cyclopædia* or *The Elements of Mechanics*, London, 1830, p 286. See EQM page 2237 for the full quotation. This entry was an extract from Captain Kater's account of the new Standards of Weights & Measures, published first in *Phil. Trans.* 1826, CXVI, part II, p 1-49..

2 Henry Kater, FRS, 1777-1835, son of a bakery proprietor in Bristol who insisted that his son train to be an attorney; when his father died he joined the Army at 17, and worked in India surveying the sub-continent. Received one year's training at the Military School of Engineers at Sandhurst when he was 31. Married in 1810, and had three children. Because of his enthusiasm and skill in metrology he was chosen to work on the new Standards of W & M in 1825. He worked on the Russian Standards of W & M (leading to the later connections between Mendeleev and the Board of Trade, discussed in EQM, p 2076-82), worked on pendulums and vibrating seconds (for which he got the Copley Medal) and on telescopes and floating collimators. He contributed regularly to *Phil. Trans*, writing lucidly and precisely in language that the layman could understand.

MacMillan, D S, *The Kater Family 1750-1965*, Sydney 1966.

3 Science Museum, no. 1914/578, on loan from L Oertling.

4 Kater, as the inventor, worked closely with R B Bate, as the maker, on many instruments, for example, Bate made Kater's Improved Prismatic Compass, now in the Chatham Royal Engineers Museum.

5 Science Museum, no. 1914/577, on loan from L Oertling.

6 *Standards Commission Minutes of Proceedings, 23rd Meeting, 21 Dec 1869.* DeGrave quoted the same price for a mahogany beam as for a gun-metal beam in 1869. Considering how accurate the casting of gun-metal was in 1824, the decision to use mahogany is interesting. Did Kater consider the use of gun-metal when designing the first version?

7 Thanks to A J Crawforth for drawing this to my attention. The weight bears no verification marks, not even those of the Exchequer, so probably came from a private source, such as another Bank.

8 McConnell, A, *R B Bate of the Poultry*. This trade-card is illustrated on p 38. The trade-card included reference to J Braham who finished working in 1838, and to Dawson and Melling who started work in 1837.

9 McConnell, A, *op cit*, p 63, note 55. G B Airy was the Astronomer Royal, and deeply involved in metrological work. He was the Chairman of the Commission appointed to enquire into the Condition of the Exchequer Standards, 1867-68. He considered his records to be of historic importance, so never threw away any paper-work without considering its potential future use. This valuable resource was studied intensively by Dr. John Chaldecott. The records are now held at the Manuscript Department, Archivist Adam Perkins, Cambridge University Library, West Road, Cambridge, CB3 9DR.

Chaldecott, J A, Printed Ephemera of Some 19th-century Instrument Makers, *Studies in the History of Scientific Instruments*, ed. Blondel, Parot, Turner & Williams, London, 1989.

10 McConnell, A, *op cit*, p 21.

McConnell, A, private communication. The mahogany plank 2½ inches thick, cost R B Bate £5. 15. 0. PRO T. 1/4358, D40 sheet G2.

11 *Phil Trans* 116 (2) 1826, 1-49, p 9.

12 McConnell, *op cit*, p 21.

13 Read, H, Grandfather's Standards, *EQM*, p 2076-2082.

Bob Holdaway points out that, although measures were only checked every 10 years, weights were checked every five years, as the wear on weights made them unreliable more rapidly.

14 *Standards Commission, Appendix VI to the Fifth Report*, Part 1, p 80-81. See also EQM, p 2080.

15 *Standards Commission, Minutes of Proceedings*, 23rd Meeting, 21 Dec 1869, p 6.

16 *Standards Commission, Appendix VI to the Fifth Report*, Part 1, p 82. Confidence in the mahogany is implicit. It would have been replaced in 1867 if the Board of Trade officials had any doubts about its efficacy.

17 Morris, A, Private communication, reporting a conversation he had with an elderly employee of the Board of Trade who remembered using the balance at Chapter Street.

Acknowledgements

With thanks for their help in preparing this article to C Berridge, K Brown, D Crawforth-Hitchins, R Holdaway, A McConnell, A Morris, B J Oliver and A J Simcock.

Biography

Peta Buchanan spent many years teaching chemistry before researching the early history of platinum and scientific instruments, and co-authoring papers on *Electroplating the Platinum Metals*, and *Boyle's Colour Changes* and publishing *Richard Knight (1768-1844): a forgotten Chemist and Apparatus Designer*. She gained a doctorate with her thesis on chemical, bullion and assay balances and their weights. The results of work on the lives and backgrounds of some of the instrument makers and their customers form the basis for talks to groups interested in history and family studies. Gardening is her antidote to so much research. She is respected and appreciated for the cheerful way she gives unstinting help to other researchers, encouraging and stimulating them to further efforts.

The editor would be amazed and delighted if evidence appeared of more R B Bate mahogany beams and would publish such evidence.

Contemporary Comment, 1830

The Cabinet Cyclopaedia or The Elements of Mechanics, by Captain Henry Kater V.Pres.R.S. etc., & Rev. Dionysius Lardner, LL.D F.R.S. etc., London, 1830, p 286 -8.

The weight of the bushel measure, together with the 80lbs of water it should contain, was about 250lbs; and as I could find no balance capable of determining so large a weight with sufficient accuracy, I was under the necessity of constructing one for this express purpose.

I first tried cast iron; but though the beam was made as light as was consistent with the requisite degree of strength, the inertia of such a mass appeared to be so considerable, that much time must have been lost before the balance would have answered to the smallest differences I wished to attain. Lightness was a property essentially necessary, and bulk was very desirable, in order to preclude such errors as might arise from the beam being partially affected by sudden alterations in temperature. I therefore determined to employ wood, a material in which the requisites I sought were combined. The beam was made of a plank of mahogany, about 70 inches long, 22 inches wide, and 2¼ inches thick, tapering from the middle to the extremities. An opening was cut in the centre, and strong blocks screwed to each side of the plank, to form a bearing for the back of a knife-edge which passed through the centre. Blocks were also screwed to each side at the extremities of the beam on which rested the backs of the knife-edges for supporting the pans. The opening in the centre was made sufficiently large to admit the support hereafter to be described, upon which the knife-edges rested.

In all beams which I have seen, with the exception of those made by Mr [T C] Robinson, the whole weight is sustained by short portions at the extremities of the knife-edge; and the weight being thus thrown upon a few points, the knife-edge becomes more liable to change its figure and to suffer injury.

To remedy this defect, the central knife-edge of the beam I am describing was made 6 inches, and the two others 5 inches long. They were triangular prisms with equal sides of three-fourths of an inch, very carefully finished, and the edges ultimately formed to an angle of 120°.

Each knife-edge was screwed to a thick plate of brass, the surfaces in contact having been previously ground together; and these plates were screwed to the beam, the knife-edges being placed in the same plane, and as nearly equidistant and parallel to each other as could be done by construction.

The support upon which the central knife-edge rested throughout its whole length was formed of a plate of polished hard steel, screwed to a block of cast iron. This block was passed through the opening before mentioned in the centre of the beam, and properly attached to a frame of cast iron.

The stirrups to which the scales were hooked rested upon plates of polished steel to which they were attached, and the under surfaces of which were formed by careful grinding into cylindrical segments. These were in contact with the knife-edges their whole length, and were known to be in their proper position by the correspondence of their extremities with those of the knife-edges. A well imagined contrivance was applied by Mr. Bate for raising the beam when loaded, in order to prevent unnecessary wear of the knife-edge, and for the purpose of adjusting the place of the centre of gravity, when the beam was loaded with the weight required to be determined, a screw carrying a movable ball projected vertically from the middle of the beam.

The performance of this balance fully equalled my expectations. With two hundred and fifty pounds in each scale, the addition of a single grain occasioned an immediate variation in the index of one twentieth of an inch, the radius being fifty inches. From the preceding account it appears that this balance is sensible to $^{1}/_{1750000}$ part of the weight which was to be determined.

Contemporary Comment, 1825

from J KATZ

This letter and the attached quotation was sent by general ironmongers,[1] Landale & Tod, on behalf of R B Bate in the hope of obtaining an order. It is typed because the original is difficult to decipher.

[To] The Hon[era]ble The Provost of Dumfermline

5 Hunter Square

Sir.. Edin Febru 28 1825

No order having been received from your Burgh for a Set of the New Imperial Standard weights & measures, and an opinion having become public, that Mr Bate was making an exorbitant Charge, we trouble you with the annexed, and are Sir,

Your Mo[st] ob[edient] ser[vants] Landale & Tod

The above manuscript letter had this printed form below attached to it:

Poultry, London, [scored through] 25th February, 1825

REFERRING to my Letter of the 6th September last, respecting the New Standard Weights and Measures, I now beg leave to hand you full particulars of the two varieties which I intend to make. I have affixed the expense to each (as nearly as the variations required in their engraving, and the rapid advances which are taking place in the price of metal, will allow), and I can, *for the present*, undertake that they shall not either of them *exceed* its respective estimate: which, as the expense of verification is the same in each, is quite as low as they can be made for, without using materials of such a quality as would be really unfit for the purpose.

I am also about to make Scale Beams on an entirely new construction, and shall be happy to supply you with such as may be required; which, together with the Standards themselves, you may rely upon being executed with the *utmost accuracy*: indeed (and I trust that the numerous applications made to you will be considered as an apology for my urging this consideration) the means which I am *necessarily*

employing in making the *originals*, will secure this advantage for all which pass through my hands; whilst others must be copies, and, for the most part, copies of a copy.

I am *Sir*, Your faithful and obedient Servant, R B Bate

Mathematical Instrument Maker to His Majesty's Board of Excise.

BEST SET

The Bushel,-made of such figure and dimensions as to represent both the corn and heaped measure, and accompanied by a gauge, determining the height of the cone in the latter.

The Half-Bushel, Peck — made for the first time of *proportionate* figure and dimensions, so as to determine the true capacity of each heap, with similar gauges.

The above having handles attached to their *bottom* to prevent alteration of figure in lifting.

The Gallon with its 10-lbs weight,
Half-Gallon " " 5-lbs do.
Quart " " 2½-lbs do.
Pint " " 1¼-lb or 20-oz do.
Half-Pint " " 10-oz do.
Gill " " 5-oz do.
Half-Gill " " 2½-oz do.

These six vessels being conical, with rims rising from their bottoms which serve as handles, and defences against bruising.

The Standard Yard, comprising the Rod divided into feet, with its bed complete.

The Standard Pound, viz, *Troy*, of a spherical figure, with its sub-divisions likewise spherical, as far as 1-dwt and the grains of platina.

The set of Avoirdupois Weights, spherical throughout.

In the construction of the above, every attention has been paid to convenience and durability: they will be made of metal equal in quality with that used for the Exchequer Standards, and may truly be called "Models" of them; being throughout similar to them in figure, and having their stamped denominations affixed with the same tools, which have been contrived expressly for the purpose.

The expense of the whole, including the Exchequer Fees and Indenture, will be from £100 to £120.

SECOND SET

This set will be of similar metal to that used in the best at present made for Towns and Counties; it comprises every thing included in such sets, with the addition of the Imperial Troy Pound and its subdivisions: the whole expense, with the Exchequer Fees, etc, as above, will be from £70 to £80.

The Bushel, Half-Bushel, Peck — made of the same dimensions and proportions as the superior set, but with handles to the sides as usual.

The Gallon, Half-Gallon, Quart, Pint, Gill, Half-Gill — made cylindrical, as usual, and without the new water weights.

The Standard Yard, being the bed only, as usual.

The Standard Pound, *Troy*, newly arranged, cup-shaped, as far as 1-dwt and the grains of sheet brass.

The set of Avoirdupois Weights, 56-lbs to ¼-lb being bell-shaped, and the 2-oz to ½-dram flat, as usual.

Editor's Comment:- Not all Authorities bought their New Imperial Standards directly from the maker, although it seems probable that most did do so.[2] Bate is known to have used agents to sell his Admiralty Charts[3] so it is reasonable to assume that he used agents in Scotland to encourage sales of instruments.

Throughout 1825 Bate prepared numerous small weights and made repeated weighing operations to derive the Avoirdupois weights from the Troy series. Kater made similar comparisons but by a different route, with the help of Thomas C Robinson, as a check on the results.[4] This suggests that, in spite of Bate's offering to sell Standard Avoirdupois weights to the Local Authorities, he was not quite ready with a definitive version in February 1825.[5]

Bate's heart-wrenching description[6] of his heavy work-load between August 1824 and October 1825, preparing the Standards for Kater, leaves us wondering whether he had an excellent foreman who instigated and delivered the orders for Standards or whether Bate was exaggerating when he described the length of hours given to Kater's needs; *I was devoted to the execution of these [Exchequer] Standards, denying myself to other calls during the hours of business and not beginning any other*

work 'till after 8 o/clock PM, which very frequently engaged me during 6 and sometimes 8 hours more to the injury of my health and derangement of my family.......I did not touch any other Standards, except the working set of Measures for the Exchequer, or make advantage of them in any way, 'till the end of those 14 months, but lost many orders and had others countermanded because I could not execute them when others did;......The period when I was thus called upon was that in which our workmen were the fullest of employment they were ever known to be, when the difficulty of getting additional hands was extreme and that of inducing anyone to undertake those parts which were too heavy for me was so great that I applied to four of the most competent in London without success altho' they were told that I had orders to pay them well.

So why was Bate getting printed in February 1825 a leaflet that requested large orders? And why did he say that he didn't touch any other Standards?

Bate's prices *may* have been exorbitant, although Landale & Tod obviously thought them reasonable, and made no attempt to justify the high price in their letter. The relative costs of three of the makers of Standards was provided by the Town Clerk of the City of Westminster. In 1829 Bate's set had cost £187, (kept locked up as the ultimate reference), DeGrave's set cost £113 (used to verify Working Standards) and Young's set, presumably the cheapest, used by the Jury on its perambulations.[7] The difference in the cost between the quotation above of £100 to £120 and the cost of Westminster's set may be accounted for by the great cost of having the Coat of Arms of Westminster engraved onto each piece, being £10 for the Bushel alone.[8]

If the sets were really so exorbitant, how was it that 126 sets were made by Bate[9] for Authorities in the one year after the passing of the 1824 Act? Could so many Authorities have been extravagant? Perhaps they believed that it was well worth paying the extra, and getting the work done by the man that Kater thought the best able to make accurate Standards. The reputation of the firm was solidly grounded, as proved by Bate's making a huge number of Standards following the passing of the 1835 Act, many of which have survived and are kept in W & M Departments, or have been sold by major auction houses.

The main reason for printing this letter in this issue of EQM, is to point out that Bate was offering to Local Authorities his *Scale Beams on an entirely new construction.* This is evidence that Bate anticipated selling his new wooden-beamed scales to Local Authorities. If any ISASC member can confirm that Bate did sell them, please inform the editor so that Dr Buchanan *can* advance on six!

Notes and References

1 Edinburgh Reference Library. Landale & Tod, General Ironmongers, 5 Hunter Square, Edinburgh, George Landale, home address, 5 Hailes Street, Edinburgh. *Trade Directory 1825.*
Midlothian Reference Library. Landale & Tod, Wholesale Ironmongers, 8 West Register Street, Edinburgh, *Trade Directory 1827.* Note the up-grading to wholesale ironmongers.

2 Biggs, N, *Antique Weights*, Egham, 1998, p 8. The North Riding of Yorkshire bought 12 sets of Standards from Spencer & Phillips, Ironmongers, of Holborn in 1795 and 1796.

3 Clifton, G, *Directory of British Scientific Instrument Makers 1550-1851*, London, 1995, p 22. 9 agents listed.

4 McConnell, A, *R B Bate of the Poultry 1782-1847*, London, 1993, p 21.

5 McConnell, A, private communication. Lanark JPs send a resolution to the Treasury in 1825 pointing out that Bate had failed to produce the items ordered. Glasgow JPs deplore Bate's delay and request postponement of the operation of the Act of 1826 as other county's W & M were delayed too. PRO T. 1/4358.

6 McConnell, *R B Bate of the Poultry 1782-1847*, p. 21-22.

7 McConnell, *R B Bate of the Poultry 1782-1847*, p.23.

8 McConnell, private communication with typed copy of documents relating to Bate, including Jackson & Donne's invoice for engraving Coats of Arms in 1825. PRO T. 1/4358.

9 McConnell, *R B Bate of the Poultry 1782-1847*, p 28.

ISASC

EQUILIBRIUM

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

1998—ISSUE NO. 3 PAGES 2253-2280

Notes & Queries

N & Q 137	From H SLAETS

I have recently acquired an English coin scale with a badly damaged label, shown on the front Cover. Can you decipher it, and give me any information on the maker?

N & Q 137 Reply	from the Editor

The damage is not as catastrophic as it might be. See Fig. 2. The label says *Richard / Brocke / Scalemak / er From / London / Liveing / .... the / Bridge / Geate / Chester* round the Coat of Arms used by Queen Anne between 1702 and 1707. These dates tie in very nicely with the internal evidence provided by the box of scales. The style of writing with open lettering was new in c.1700, and remained popular for the next 30-40 years.

Richard Brocke, son of Phillip of Westchester, Cheshire, pewterer, bound to Thos. Collet (Beadle) for 7 years on 1 Sept, 1681. This entry in the Binding Book of Blacksmiths' Co. in London needs little explanation. Richard was probably 14 years old when he travelled down to London from Chester (the modern name for Westchester), and we might assume that he already knew quite a lot about working metal from his father. Nothing was known about Thomas Collet, and there were doubts as to whether he was a scalemaker. But because he trained a proven scalemaker, he will now be included in the records as a scalemaker himself.

Richard Brocke was freed in 1688/9, and started his working life with an apprentice, John Evitt, bound to him. John Evitt had started his training with Elizabeth Marsh, widow of a well-known London scale-maker. This tradition of putting a partly-trained apprentice with a young and inexperienced

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scalemaker was continued well into the 18th century, and must have eased the stress for the young master. In this case, John Evitt was turned over to yet another master, Edmund Jenks, for the final stages of his training, but nothing in the records explains the reason for this. Was John Evitt moved because Richard Brocke wanted to return home to Chester? It is a reasonable supposition, because we can deduce from this scale that Richard Brocke had a successful business in Chester that required him to have new, fashionable trade-labels printed in about 1702, so he probably returned to Chester a while before that, in, say, 1694.

Fig. 2. The trade-label with a nice ornamental border. Photo H Slaets

As this is the first scale by Richard Brocke to appear, nothing can be said about the range of his skills, but another Richard Brocke is recorded as a pewterer in Chester in the 1750s. Just possibly, this is "our" Richard as a very old man, continuing the trade of his father, or he might be the son of "our" Richard, returning to the trade of his grandfather. It would be surprising if there were enough opportunities in a small market town like Chester for a man to earn his living exclusively by selling scales, even if he made a full range from tiny coin scales to huge 6 foot trade scales. It would seem more reasonable to think of his following two trades, and advertising either one of them as appropriate. [There are examples known of scalemakers having a second trade-card that mentioned their other trade, with no reference to their scalemaking.]

The nesting weights in this box fit very nicely into the socket, but they were made many years after Richard Brocke died, in fact, after the 1878 Act[1] permitted the use of bullion weights with decimal fractions. When Richard Brocke was working, the silver coinage in England was very badly worn away, and many coin-scale boxes incorporated a set of nesting weights for four coins, the 5 shilling, 2 shillings and 6 pence, the shilling and the sixpence coin. Used in conjunction with the little grain weights, the amount of silver lost could be ascertained and the value of the coin agreed, although it is more likely that the weights were used as bullion weights, that is, putting the travesties of silver coinage into one pan until they balanced against a specifically-valued nesting weight. So, if 5/- worth of silver was needed, any silver could be used as long as the sum-total balanced a 5/- weight.

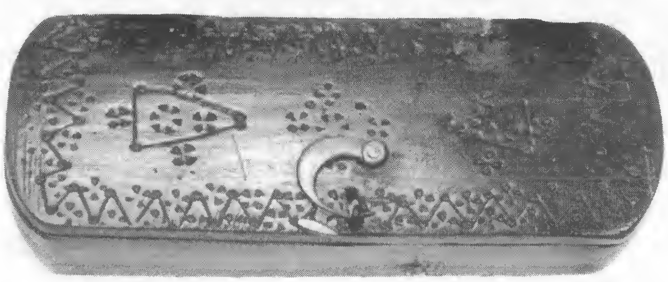


Fig. 3. Fruit-wood box with simple book-binders' stamps forming an unusual pattern. Photo H Slaets

The monetiform weights in the box include a Charles I weight designed by Briot[2] shortly after 1632, for checking the gold unite; a Lud [Louis] XIIII weight,[3] made in England around the right time for its use by Richard Brocke, for checking the pistole, [a French gold coin widely circulated in Britain] and a lovely half-moidore weight[4] from a 'long set' of coin weights for the Portuguese pieces, the moidores and the guineas with their fractions, current between about 1740 and about 1775.

The beam is of the new 18th-century design, with a less-heavy pendant, a round-section beam and a round pointer. Usually such beams had at least the vestige of a cupid's bow under the fulcrum, but Brocke omitted it. The flimsy copper pans are conventional for the period, and I would expect the cords and tassels to be vivid apple green and made of a plait that would not un-twist. I suspect that the cords in this case are replacements. [Because the copper was so thin, it frayed the silk, the cords frequently wore away and had to be replaced.]

The box is either pear or apple wood, fairly soft, with a close grain without knots, originally almost white, but somebody has polished the exterior, giving a rich brown finish. The punches are not the fancy scrolls available in London, but the box-maker used the little punch to simulate six- and four-petalled flowers, with straight chisel marks to form zigzags and triangles. The local variations used in the provinces are very varied and quite distinct from London designs.

Notes and References

1 Biggs, N, *Bullion Weights*, Egham, 1995, p 24.

2 Withers, P & B, *British Coin-Weights, A Corpus of the Coin-Weights made for use in England, Scotland and Ireland*, Galata Print Ltd, Powys, 1993, ISBN 0 9516671 1 4, p 77, no. 971.

3 Withers, op cit, p 107, no. 1302.

4 Withers, op cit, p 135, no. 1623.

Notes & Queries

N & Q 138 — From H CRAWFORD

One of my Fairbanks postal scales has unusual graduations on the revolving brass steelyard beam. The graduations go from **0-8oz** by ½oz on one side, and when the beam is revolved through 180°, the graduations on the other side can be read, **0-15 GRAM-RATES**. As 8oz does not equal 15grams, I am puzzled by the units and uses for this steelyard.

N & Q 138 Reply — From the editor

The quick answer is that 1gram equals 0.035oz, and 1oz equals 28.35grams, so if one side of your beam reads 8oz, then the other side should read 8 x 28.35grams or 226.8grams. So the GRAM-RATES are not individual grams, but units of 226 ÷ 15 = 15gram units.

But this leads to the next question. Who wanted 15gram units? It had to be somebody writing letters to the continent of Europe, where the cheapest stamp covered a letter up to 15grams in weight.

The patent date on the beam reads May 21 1878, but the Fairbanks 1880 catalogue, page 15, makes no reference to this new patent design, unfortunately. The minute picture is shown here enlarged in Fig. 1, so the two straight pillars can be seen that were also used on your scale. It has the earlier, non-revolving design of steelyard, (with the "fused domes" shape of base like yours has), and Fairbanks then supplied the requisite metric information, if needed, by having a double beam:

Improved Letter Balance
Adopted by U.S. Government.
Capacity ½ oz to 8 oz........ Price 3.00.
Capacity ¼ oz to 8 oz........ Price 3.00.
Capacity ½ oz to 12 oz...... Price 4.00.
Capacity ½ oz to 34 oz...... Price 6.00.
Metric and English, with Double Beam, $1.00 to $2.00 extra.

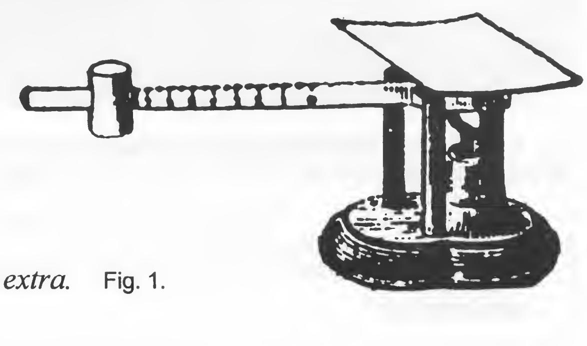


Fig. 1.

Why didn't Fairbanks have to paint or decal it "Property of the US Postal Service" or something like that? What was the policy of the Postal Service on identifying their property? Maybe yours is the private version of the scale, sold to the public, having a pretty bunch of blue forget-me-nots and a border of running gold leaves with red berries, which looks very handsome against the black enamel.

The Fairbanks 1891 catalogue does show the revolving beam, but with a change to a rectangular design of base:

Improved Postal Scales
Adopted by the US Government
WITH PATENT REVOLVING BEAM.
METRIC AND AMERICAN STANDARDS

Capacity ½ oz to 8 oz........ Price 4.00.
Capacity ½ oz to 16 oz...... Price 5.50.
Capacity ½ oz to 34 oz...... Price 8.00.

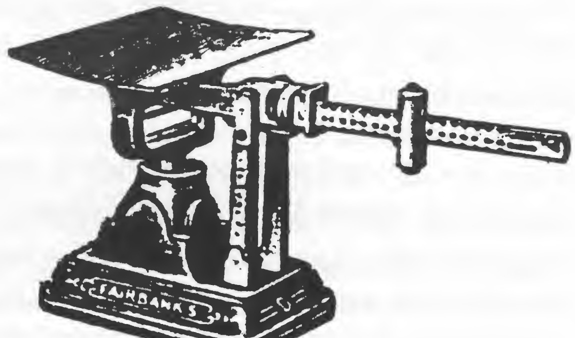


Fig. 2.

But, in a way, the Fairbanks 1906 catalogue, page 528, is more illuminating. Fairbanks was still selling the same model, with a slightly squatter poise, shown in fig. 3, not the long elegant poise that you have. But they had changed the graduations to apply to US postage only:

This Scale is arranged to indicate by direct reading in cents the amount of postage required for articles in the different classes of mail matter.

It is provided with a Revolving Beam upon one side of which is given the postage for Letters, Books, and Printed Matter, and upon the other side Newspapers, Periodicals, Merchandise.

In addition to indicating the amount of postage, the scale is also graduated to weigh in pounds and ounces, thus greatly increasing its utility for general purposes.

This Scale is made with special care, is very sensitive and extremely accurate, and for saving of time and convenience in use it has no equal.

This Scale is intended for domestic use only.

Capacity Onces	*Price Brass*	*Price Nickel-Plated*
8 x1 oz	*$4.00*	*$6.00*
16 x1 oz	*$5.50*	*$7.50*
34 x1 oz	*$8.00*	*$10.50*
64 x1 oz	*$10.00*	*$13.00*

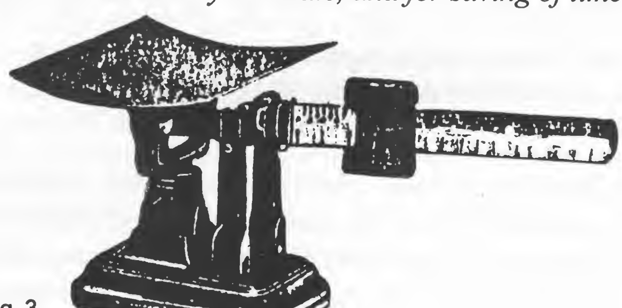


Fig. 3.

So, although Fairbanks boasted of its accuracy, W & M inspectors did not permit its use in Trade.

On the following page 529, it gets even more interesting. Fairbanks show an updated design with a fat pillar bifurcated at the top, instead of the two thin pillars that you have on yours, and it has another base design, the "bird's claw" shaped base. But the words tell us more:

The above Postal Scales and those illustrated on the preceding page have been adopted by the United States Government. The weight of postal matter is easily and quickly ascertained, the full capacity of each modification being given on the beam. All the sizes are adapted to weigh from the smallest postal unit upwards, and the largest may be used for letters as well as the smallest. The [small] Scales are especially adapted for large packages.

These Scales are made to weigh in ounces, but can be furnished in the 15 gramme weights adopted by the Universal Postal Union.

Capacity 4 lbs x ½ oz..........Price $8.00
Capacity 6 lbs x ½ oz.........Price $12.00
Capacity 10 lbs x ½ oz.........Price $13.50
Capacity 15 lbs x ½ oz.........Price $15.00

So Fairbanks *were* thinking about the Postal Union. That came into force in Britain in 1875 and was in force until 1906. So what more sensible than inventing in 1878 a revolving beam to cater for that Union? (The Postal Union was intended to speed post across all countries that were signatories, without the person sending or receiving the letter having to pay multiple postage to cover each country the letter had crossed.) As Europe was working in grams, both Britain and United States needed special arrangements to co-ordinate with gram units. Hence a 15 gram unit.[1]

The story continues, albeit without the interesting revolving beam, with the comments with their double beam Postal Scale, in the Fairbanks 1919 catalogue p 16, and the Fairbanks Morse & Co 1927 catalogue p 22[2]: *...Regularly graduated in ounces, but may be furnished graduated according to the 20gram rates adopted by the Universal Postal Union in 1906....*

Owning the same scale as you, and like you, enjoying the slim poise with equal mass above and below the beam, I am grateful to you for drawing attention to the 15gram units, which I had failed to notice. Did any other American company provide scales for the Universal Postal Union? If I lived in USA I would attempt to collect each of these variations, to demonstrate the international outlook of Fairbanks over a fifty year period.

Notes and References

1. 1/3 and 2/3oz weights were put with English roberval postal scales, and graduations were marked onto instant-readout scales at 1/3 and 2/3oz, or sometimes at 1/4oz, to give a rough approximation of 15g.
2. Fairbanks seem to be unusual in the superb comments that they included in their catalogues. Because of this, those of us interested in history are able to learn an immense amount by using their catalogues in sequence.

Response on Anderson Scale

BY N GLUCK

Mysterious is precisely the right adjective to describe Joe Wiley's scale, EQM, p 2227-2230. After hearing from our editors that the article he was preparing might require a response, I was so intrigued that I asked Ted Stein whether I might look at his Anderson scale. Although he was about to leave on an extended business trip, he kindly made arrangements with Jean to let me examine and photograph the scale.

What a beauty it is! And what a puzzle! As Joe says, it was undoubtedly produced for use in the public view, yet it has several features that make that use unlikely. I showed my photographs at a luncheon of retired Directors/Sealers from six California counties. No one had any idea what kind of business would have used such a scale. In fact, they all agreed that they personally would have condemned it for commercial use. But this is California, 1998, and the scale was produced in Indiana both before and after the patent was issued on Oct. 6, 1906, when regulations were less stringent than today. How to find out whether the scale was used in trade, and if so, by what type of business? After several months of searching for the necessary records I can't yet identify the type of user. I can, however, shed some light on Joe Wiley's other queries.

The Anderson Computing Scale can generally be considered a trip scale since it has no special indicator to determine a balanced condition. It utilizes a modified Roberval principal (the pans have a parallel guidance system). If this model had been approved for trade, the correct name would be a nonautomatic-indicating equal-arm counter scale. The computing chart with its frame is part of the main lever, and the brass knob is both a poise and part of the index.

The "semispherical" mass or weight attached to the underside of the chart is not a damper. It is, in fact, a variation of Schickert's Principle.[1] Because the chart with its frame is above the pivot line, a mass must be added to stabilize the lever system. If that weight were removed it would be like trying to balance an ice cream cone on its tip end, unstable. When a lever system is unstable it is considered to

be *accelerating*. All mechanical, equal-arm, analytical (high resolution suitable for chemical analyses) balances have an adjustable gravity weight in line with the fulcrum pivot for this purpose.[2]

Under current regulations, the two primary requirements for approval are that a device does not *facilitate the perpetration of a fraud* and that it maintain its adjustments under stress for a reasonable period. The design of this model would be rejected outright because the "deadloading" feature of exceeding the capacity of the chart to reach the scale capacity facilitates fraud. The fact that the chart cannot be seen from a *reasonable customer position* and that two different systems (avoirdupois and troy) are being indicated simultaneously when an object is weighed would be other reasons for non-approval. Could this scale have been used in trade in 1906? Probably, but not for long.

Although the National Bureau of Standards (NBS) was established in March, 1901, the National Conference on Weights and Measures (NCWM) was not established until January, 1905 to develop model laws on rules and regulations, tolerances, and specifications for all weighing and measuring devices.[3] In the United States; only the NBS or any state in contract with that agency can approve a weighing or measuring device to be used in trade. Obviously, it could have taken several years to formulate and publish those regulations, to distribute them to the States and to set up contractual relationships. Stein's scale was produced between May 16, 1906, when the patent was applied for, and Oct. 2, 1906, when it was issued. Wiley's was made between issuance of the patent and whatever date the new regulations were enforced in the State of Indiana. Any scale can, of course, be used non-commercially to suit the owner's needs. It could have been used to check incoming merchandise, in connection with internal manufacturing processes, or for inventory purposes. But the market for so handsome and probably expensive a scale to use behind the scenes was undoubtedly limited. And that explains why Joe Wiley's scale is so rare.

Biography

Nahan Gluck joined the Los Angeles County Department of W & M in 1957 as a vehicle inspector and was given the opportunity to develop the department's metrology laboratory in 1961. The *Man on the Moon* Project had just begun and the aerospace people needed mass calibrations far more precise than those needed for legal W & M. He went to the National Bureau of Standards in 1962 to learn Techniques and Procedures as well as certifying directly traceable mass standards. He graduated from California State University in 1970 with a Bachelor of Science Degree in Electronic Engineering, became Assistant Director in 1978 and Deputy Director of Los Angeles Department of W & M in 1984. He served on the Advisory Board at California State University Dominguez for their Masters' Program in Quality Assurance until he retired in 1993.

He married Carolyn in 1958, and got his certificate as an advanced SCUBA diver in 1972, joined the California Wreck Divers to assist archaeologists, and joined the Underwater Photographic Society strictly for fun, still dives regularly and should soon be certified to use Nitrox. He is restoring his 1929 Ford Model A coupé, and is a volunteer at the Japanese American National Museum in Los Angeles' Little Tokyo, which he finds very exciting and satisfying.

Notes and References

1 For clarification, see Crawforth's *Handbook of Old Weighing Instruments,* p 75, fig. 41. For a more common use of the terms *weight* and *mass*, see p. 92.

Technically, the lead weight or mass should be called a *frustum [slice] of a sphere* since it is less than half of a sphere.

2 For detailed information on the terms *gravity, pendulum*, and *sensitivity* weights, see Christian Becker, *Care and Use of Analytical Balances*, p 8; Crawforth, *Handbook of Old Weighing Instruments* p.70, fig.26; Mettler, *Dictionary of Weighing Terms, pp 27, 101; NBS Handbook 94,* pp 102, 148, 150.

3 The National Bureau of Standards (NBS) became the National Institute of Standards and Technology (NIST) in 1988. The NBS was originally established in 1901 as the government's science and technology laboratory for measurement, technology and research on standards. Over the years it evolved to become the sole federal agency directly concerned with aiding industry and commerce. The NIST continues to provide the traditional measurement, calibration, data and quality assurance support that were supplied by the NBS, together with several new programmes that support the aggressive use of new technologies in American industry.

Oertling Verified Unequally?

BY P BUCHANAN

Ludwig Oertling of London was renowned for his high-quality, good-value, conventional balances during the second half of the 19th century. In his catalogue of 1891, he showed forty-seven equal-arm balances (twenty-three chemical, eleven assay, five Inspectors, seven bullion and one diamond balance), one coin sorter, and one steelyard for determining specific gravity; all quite conventional for the period. However, he put at the end one dual-principle "balance", the ***Inspectors' Balances, no. 5 Portable***, which could be used either as an equal-arm balance or as an unequal-arm beam.

A tantalising note was written by G B Airy[1] to Oertling in 1872. I *am desirous of fixing in a wall* [at the Royal Observatory, Greenwich] *for public access a balance concealed in all important parts except the scale-pan, by which tradesmen can test their one-pound weights (7000 grains), showing the error in grains of excess or defect, say up to + or - 50 grains...*[2] Insufficient information is given to allow definite identification of the quick-weigher as being similar to the design in the 1891 catalogue, (and indeed, it indicated above and below automatically, which the Inspector's Balance no. 5 did not) but conceivably Airy's design provoked the ideas leading to the design of the Inspector's Balance, no 5.

Searching back through Oertling's earlier catalogues, this "balance" is first found in the c.1880 catalogue with the illustration seen in Fig. 1. *Inspectors' Portable Balance No. 1, as supplied to the*

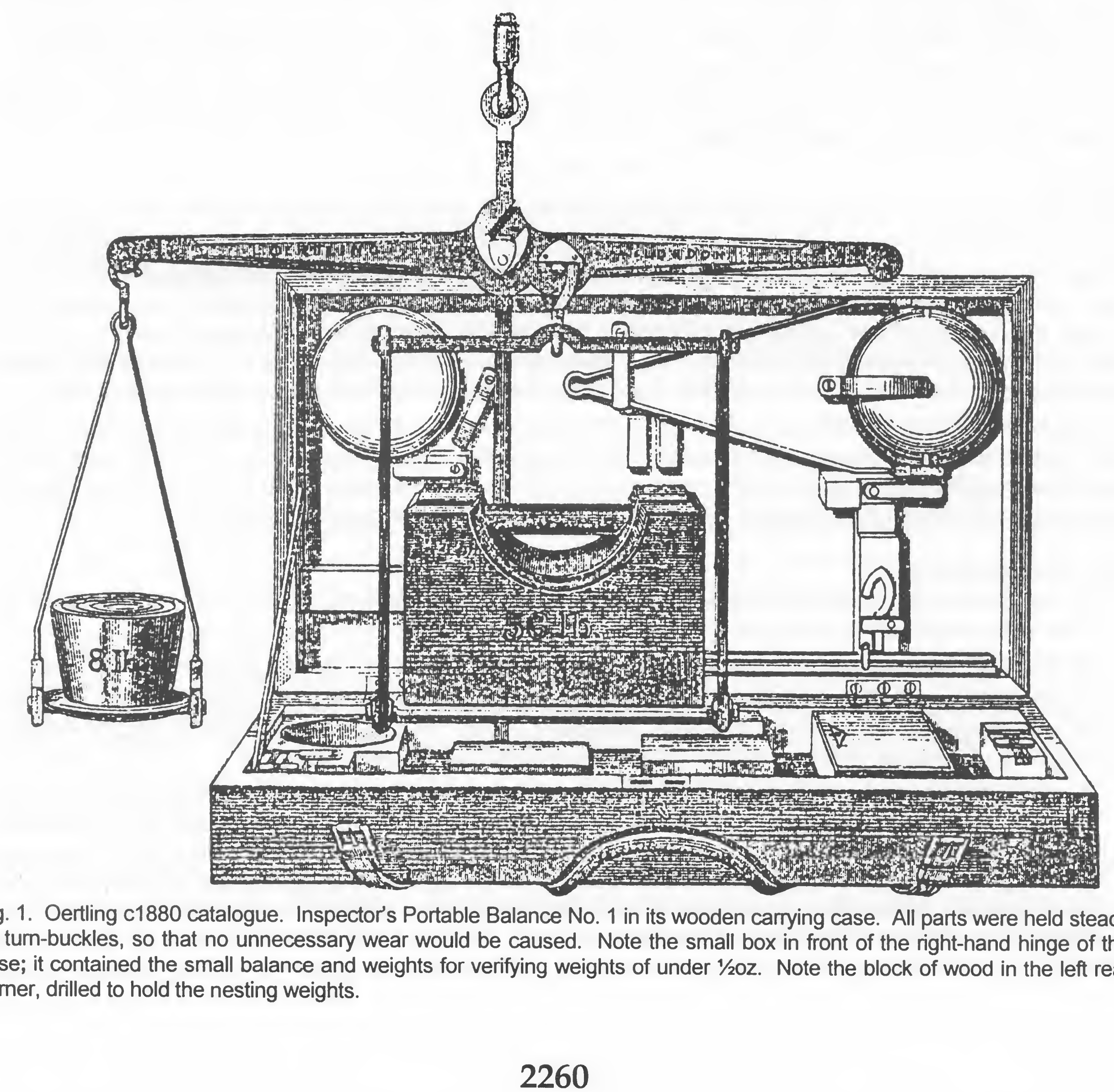


Fig. 1. Oertling c1880 catalogue. Inspector's Portable Balance No. 1 in its wooden carrying case. All parts were held steady by turn-buckles, so that no unnecessary wear would be caused. Note the small box in front of the right-hand hinge of the case; it contained the small balance and weights for verifying weights of under ½oz. Note the block of wood in the left rear corner, drilled to hold the nesting weights.

Government of Canada, etc., Specially constructed for testing square or "brick" shaped Iron Weights up to 56 lb. When required for testing weights not exceeding 7 lb. the balance is used in the ordinary way; but for weights of 14, 28, and 56 lb., a larger and stronger pan is attached to another knife-edge, forming a short arm, so that a weight of 8 lb. is sufficient to test one of 56 lb. Size of case, 25 x 13 x 4¾ inches deep. Price £25.

Fig. 1 shows the "balance" [steelyard or short arm] in use to weigh a 56lb. weight, the 56 lb. weight being balanced by a set of nesting weights, 4lb, 2lb, 1lb, ½lb, ¼lb, ¼lb with a total weight of 8lb. The larger hanger and pan are being used on the knife-edge near the fulcrum. There was no mention of a facility for ascertaining the degree of loss of mass of the 56lb weight. Any weights used would have to be calculated as being seven times heavier than they really weighed. Thus, for example, a two grain weight would be put with the 56lb weight, balancing a 14grain loss. Any error in such tiny weights would be magnified by seven times- an unhappy thought for any inspector.

The smaller (7 times lighter) hanger and pan, to be used on the end of the arm when checking weights not exceeding 7lb, is stored in the lid of the box.[3]

Further research[4] revealed this comment in 1876 by H W Chisholm, the Warden of the Standards:
In France, every local verifier of weights and measures is supplied by the Government with a nécessaire de vérificateur, or kit of all the necessary instruments for verifying weights and measures of the metric system, so arranged as to be conveniently carried by the verifier. A full description of this nécessaire is given in the Second Report of the Standards Commission,[5] on the law and practice of the metric system in France. (See below.) Having thus been brought under the notice of the Standards Commission, it was considered desirable by them that means should be adopted for furnishing a similar portable collection of verifying instruments applicable to Imperial weights and measures for the use of local verifiers in this country. Under my direction, therefore, Mr. Oertling has now constructed a model kit to be deposited in the Standards Office, copies of which can be made for such of the local authorities as may order them for the use of their verifying officers, and which may be more authoritatively adopted in the event of the recommendations of the Standards Commission being carried out for improving the system of verification in this country.

This model kit is also amongst the instruments of the Standards Department now exhibited at the Loan Exhibition of Scientific Apparatus at South Kensington.[6] It differs so far from the French nécessaire that it contains only verifying instruments, whilst the nécessaire contains also stamps and stamping instruments. The verifying instruments are contained in a flat box, 24 inches x 12 x 4½ deep, opening longitudinally, and provided with a strap for slinging over the shoulders. It is furnished with two handles to facilitate its transport, a lock and key, and two hooks to keep it closed. Its total weight when fitted is 30 lbs.[7]

The several verifying instruments are made to fit in compartments for receiving them. They are as follows:-

1 A strong equal-armed balance constructed also to be used as a septimal balance, the beam having on one side an additional knife-edge, placed one seventh of the distance from the central to the right-hand outer knife-edge. The balance is separated into five parts when fitted into the box; the column, the beam, the two pans of the equal-armed balance, and the additional pan for the septimal balance. The balance is set up by screwing the column into a screw socket fixed in the box. It is available for comparing the heavier weights of 14, 28 and 56 lbs., when placed successively in the additional pan, and counterpoised with the Standard weights equal to 2, 4 and 8 lbs. respectively placed in the weight pan; and it will show an error of about 8 grains with a 28 lb. weight and 30 grains with a 56 lb. weight.

It is used as an equal-armed balance for verifying weights from 7 lbs. to 1 oz. inclusive, and will show an error of 1 grain in a 1 lb. weight, and half a grain in a 1 oz. weight.

2 A small equal-armed balance fitted in a separate box for verifying weights of ½ oz. and under. It turns easily with an additional weight of 0.02 grain.

3 A set of pile [nesting] *weights of 4, 2, and 1 lbs, and of cup weights 8 drams to ½ dram, weighing together 1 lb; and a set of grain weights from 6 grains to 0.1 grain.*[8]

4 A yard measure....

5 A flat hollow brass gauge....for testing measures of capacity from the bushel to the half-gill...

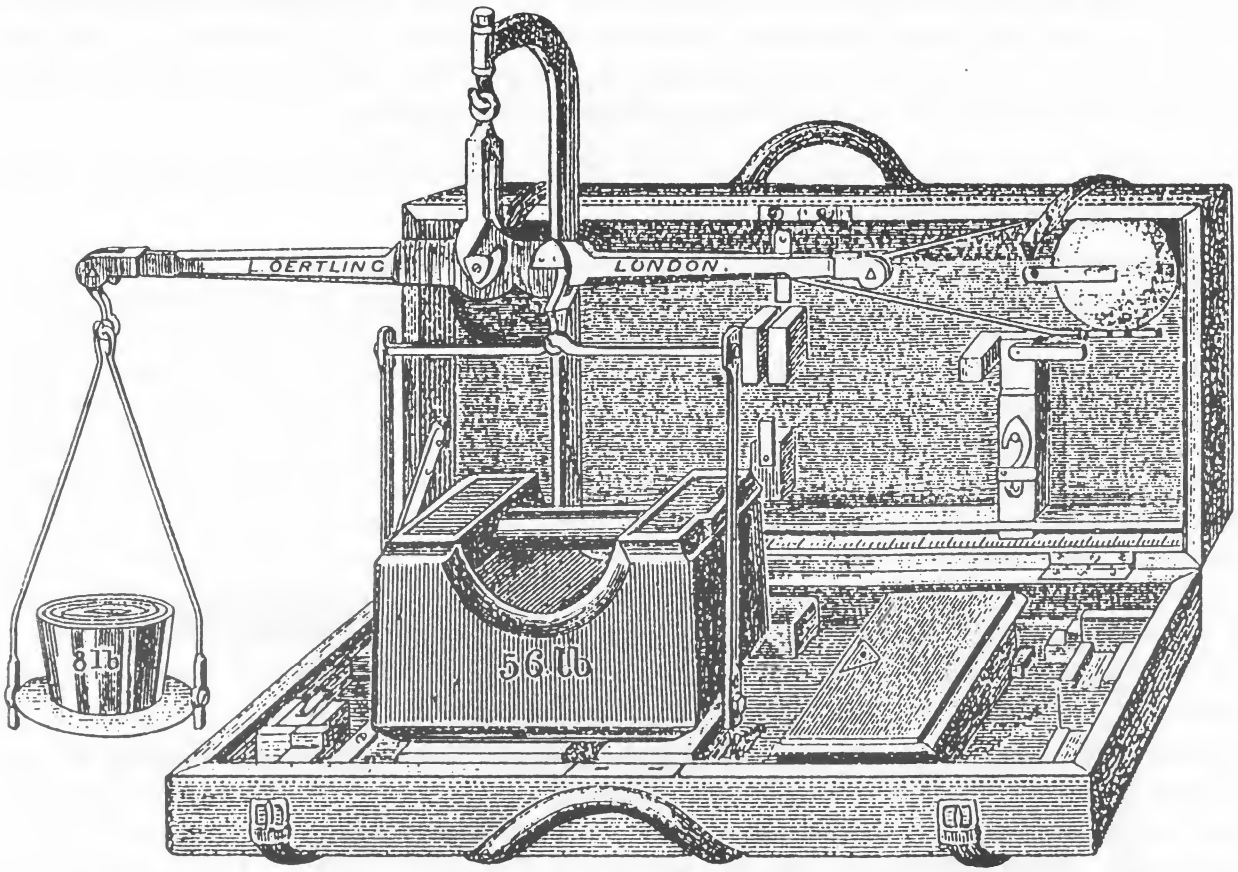


Fig. 2. Oertling 1891 catalogue. Inspectors' Balance No. 5 -Portable, 25 x 13 x 4¾ ins. Oertling had not altered the design, but had a new cut made. A Folding Yard and Dry Measure Gauge are included in the case.

There seem to have been no Regulations regarding the balances used by Inspectors in Britain. Apparently, each Authority could buy whatever balances thought suitable, from any manufacturer, as long as Official Weights and Measures were used with those balances. The Board of Trade was alerted by the Fourth Report,[9] written in 1870, to the need to tighten up the controls:

(49) That the form, material, etc, of all local standards, together with the balances, stamps, and other apparatus used by the verifiers, be subject to such regulations as shall from time to time be issued by the Board of Trade.[10]

(50) That every Verifier have his standards, balances, and other apparatus, ready for inspection at such place and time as may be fixed from time to time by any official Inspector of Standards duly appointed.

In practice, many Authorities were very responsible in their care of balances. Samuel Robinson Short (of DeGrave Short and Fanner) gave evidence [i.e. answered questions] to the Standards Commission[11] on 7.7.1869:-

(1490) ***Do you furnish balances for the inspectors of W & M?-*** *Yes.*

(1491) ***What is the usual cost of a set of balances for Inspectors?-*** *The ordinary cost of a set of balances for testing weights is about £15 or £16, sometimes there are more expensive sets; three pairs constitute a set.*

(1492) ***What makes them occasionally more expensive; is it the material, or the greater amount of work required in their construction?-*** *Sometimes we finish them more highly, and pay greater attention to their appearance; this depends on whether they are for outdoor or indoor use. Those for indoor use are generally better then the outdoor; they are more expensive, and they remain as fixtures. The scales which the outdoor inspectors use are obliged to be very simple in their construction, whilst those which are fixed in the office may be more elaborate.*

(1493) ***Are they generally sent back to you for adjustment, and how often?-*** *Very frequently; it depends upon the place. We have them from the city [of London] and from Manchester and Liverpool about four times a year. We have a contract with the city of London to keep them always in order, and whenever there is any defect, we make it right, and the same with the county of Surrey. But the generality of inspectors are very backward in having their scales and weights put in order. But the I have here a letter relating to them from Lerwick in Zetland [Scotland]. "In reference to the beams and scales, they came into use a considerable time after the weights and measures were brought into this country, and are in as good condition now as when they were first received, they having been well kept, and only required to be used occasionally. The justices from these circumstances, and taking into consideration the heavy expense of transmitting to and from London, have resolved not to send the beams and scales at present." These beams and scales had been in use probably 40 years.*

(1505) (H W Chisholm) ***Will a balance to weigh 56 lbs., that will show the weight within five grains, keep that sensibility?-*** *For a certain length of time.*

(1506) (H W Chisholm) ***Until the usual time when it is sent for adjustment?-*** *No, it would not do that, because as the knife-edge is thickened by wear, the sensibility of the balance becomes less.*

(1507) (H W Chisholm) ***What do you think is the usual sensibility after it has been some time in wear before adjustment?-*** *I should imagine that one which originally turned with 5 grains with a 56lb weight in the pan, would take 20 grains to*

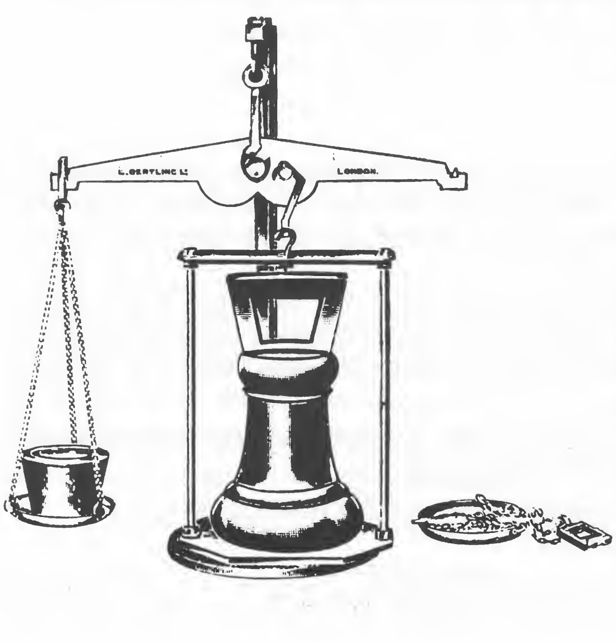


Fig. 3. << Oertling 1932 catalogue. *Portable Balance for the use of an Inspector of Weights and Measures. (Not available for Great Britain and Ireland).* There is no mention of a complete kit, no weights, no little beam, no gauge. There appear to be continuous knifes at the end of the beam, but it is impossible to see whether the hook supporting the large pan goes to the rear of the beam as well as the front, to keep the bearing symmetrical.

The balance weighed up to 5 kilogrammes used in the normal way, and up to 20 kilos using the short arm.

The ratio of the steelyard fitting was 1:10, because *'a weight of 2 kilos is sufficient to test one of 20 kilos'.*

make any impression on it when sent in to be repaired, and I have seen some of them in such bad order that I should think it would take 50 grains to move the beam, but such a case is exceptional.

(1509) (H W Chisholm) ***You think it would never do for an inspector to use steelyards in this country, as in France?*** *No, not for any nicety.*

Obviously, Mr. Chisholm did not hold the same opinion of steelyards as Mr. Short, or Chisholm would not have gone on to design his kit! The degree of error permitted in France for a 20 kilo weight (44 lbs.) was 10 grams, whereas the degree of error permitted in Britain for a 56 lb. weight was 50 grains (three grams). So, whereas a steelyard was quite appropriate for a French inspector, it seems hard to justify the use of a steelyard in Britain, especially one that even the inventor said would only weigh to 30 grains.[12]

Oertling supplied a comprehensive order to equip the newly-created Dominion of Canada[13] with the Standards required.[14] He is reputed to have had new premises built especially to provide the extra space necessary, in Turnmill Street, premises that were completed in 1874. The order was a consequence of the Canadians establishing a more-or-less uniform system of weights and measures in place of a particularly varied mixture of weights and measures that had come in with the immigrants, and had become obsolete in their countries of origin.[15]

By 1874 Canada had Imperial Standards[16] the same as Britain's, and, additionally, *Departmental Standards*, which were avoirdupois standards in a decimal series as 50, 30, 20, 10, 5, 3 and 2 lbs., and 1, 0.5, 0.3, 0.2, 0.1 and down to 0.001 pound, and it is this latter series which was mainly adopted for use in trade.[17] So what ratio steelyard did Oertling supply to the Canadians? A 1:7 steelyard would do for the Imperial Standards, but this kit was intended for outdoor inspectors, so perhaps the Canadians ordered 1:10 steelyards for checking the trade weights.[18]

Did Oertling make 1:10 versions? We have no evidence for such scales in 1874, but a surviving Inspectors' Catalogue of 1932 does illustrate such a scale, Fig. 3, *Portable Balance for use of an Inspector of Weights and Measures*, with the proviso *Not available for Great Britain and Ireland.*[19] Were Oertlings still making them for the Canadians? As the version shown was for weighing kilograms, it would only be useful for countries that used metric weights for trade weighing in 1932.[20]

If any of these kits have survived,[21] it would be most interesting to receive details.

Author's Biography

See EQM p 2249.

Notes and References

1 *Equilibrium,* p 2248. See note 9, for details on G B Airy.

2 Buchanan, P D, *Quantitative Measurement and the Design of the Chemical Balance 1750-c.1900*, unpublished thesis. '*This laudible aim was never entirely realised for, although the balance was supplied and installed, Airy found it was being damaged by 'boys' and, although repairs were undertaken, the project seems to have lapsed and the balance has been lost.*'

3 A photograph has survived of this balance, but taken at a poor angle, so that only the fittings in the lid show clearly. The photograph is one of a set that originally belonged to E Schroth (probably senior engineer to L Oertling) which he gave, shortly before he died in 1915, to Malcolm Dunbar, Managing Director of Oertlings. We are indebted to B J Oliver for this information.

4 *Tenth Annual Report of the Warden of the Standards on the Proceedings and Business of the Standard Weights and Measures Department of the Board of Trade for 1875-76*, London, 1876.

1876 Loan Collection Catalogue of Special Exhibition of Scientific Apparatus, 2nd edition, p. 36, no. 179.

5 *Second Report of the Standards Commission*, Appendix II, p. 72.

6 *1876 Loan Collection Catalogue of Special Exhibition of Scientific Apparatus.* Entry no. 179 is for this kit. Most of the exhibits were subsequently donated to the Science Museum, and can now be seen there, but

unfortunately, Curators Jane Wess and Kevin Johnson have been unable to trace this kit. It was only on loan, and the Board of Trade might have taken it back, to have it available to demonstrate to visiting Inspectors.

7 A 30 lb. box sounds a considerable load to heave around, but the more conventional Inspectors' beams, with tripod and box of weights, was greatly heavier. See page 2266.

8 Apparently the production model had slightly different weights from those originally envisaged by H W Chisholm.

9 *Fourth Report of the Commissioners appointed to inquire into the Condition of the Exchequer (now Board of Trade) Standards with Appendix*, Appendix XII, London, 1870, 428.

10 Calcraft, H G, *Model Regulations with respect to Inspectors and the Inspection of Weights, Measures and Measuring Instruments*, London, 1890. The Regulations state that *The Inspector's scale-beams should be submitted for verification by the Board of Trade at an early opportunity, and afterwards once in every five years when his standard weights are tested.*

11 *First, Second and Third Report of the Commissioners appointed to inquire into The Condition of the Exchequer Standards*, Minutes of Evidence, London, 1868, 65.

12 Calcraft, H G, *op cit*. The Regulations state that *For outdoor inspection, the inspector also should be provided with portable balances of such convenient form as his local authority may approve.*

13 Oertling catalogue of 1932: *The Canadian Government entrusted Mr. Oertling with the complete equipment of its Standards Department, including the Primary Standards and the material required by the Weights and Measures Departments throughout the Dominion.*

14 The kit was labelled "Canadian Portable Set" by Malcolm Dunbar, presumably after he was given the photograph in 1915. Was this the nick-name given to the Inspector's Portable balance, no. 5? Was it called this because only the Canadians ordered this kit?

15 *Fourth Report of the Commissioners appointed to inquire into The Condition of the Exchequer (now Board of Trade) Standards*, Appendix, London, 1870, 437.

16 Ricketts, C & Douglas J, *Marks and Markings of Weights and Measures of the British Isles*, Taunton, 1996, p 15. The Government of Canada was issued with 25 sets of Standards on 30.11.1874, and HM Naval Yards at Halifax, Nova Scotia with one set of Standards on 31.5.1875.

17 Chaney, H J, *Our Weights and Measures*, London, 1897, 42.

18 Enquiries have been made of Dr. Randall Brooks of the National Museum of Science and Technology in Ottawa, but he has not found any septimal or decimal balances by Oertling. Now that he has been alerted to their possible existence, perhaps some will be identified.

19 We are indebted to B J Oliver for this information.

20 Editor- the dates at which Canada changed to the metric system has not yet been ascertained. Please will a member send details to be published with any other material pertaining to septimal and decimal balances.

21 The Canadian Parliamentary Buildings burnt down in 1916. Did this building house the Trading Standards Department? Had the septimal balances been distributed round the country?

With what did the Canadians restock? American equipment?

Inspectors' Outdoor Beam Kit, 1910

The DeGrave Short & Co version of the Oertling Kit on page 2262 is shown in Fig. 1. Being made after the 1904 Act, it might be of greater accuracy than was demanded in 1880, but it demonstrates the point that Chisholm talked about, that is, that it was much heavier than his septimal balance. DeGrave state *When great lightness is desired, this beam and pans should be ordered in aluminium,* but the kit still needed, to use with it, two separate boxes of weights totalling over 112 lb. The tripod is not visible in the picture, but presumably they offered the ash tripod, (*being very compact and light it is easily portable*) rather than the wrought iron tripod.

W & T Avery Ltd did not even attempt, in 1897, to compete with the Oertling kit. Their 24 inch beam for verifying up to 56 lb. was made of gun-metal (a brass) with a solid beam, rather than a lattice beam, *hammered brass or copper pans and Brass oval-linked Chain which is not liable to kink. A novel*

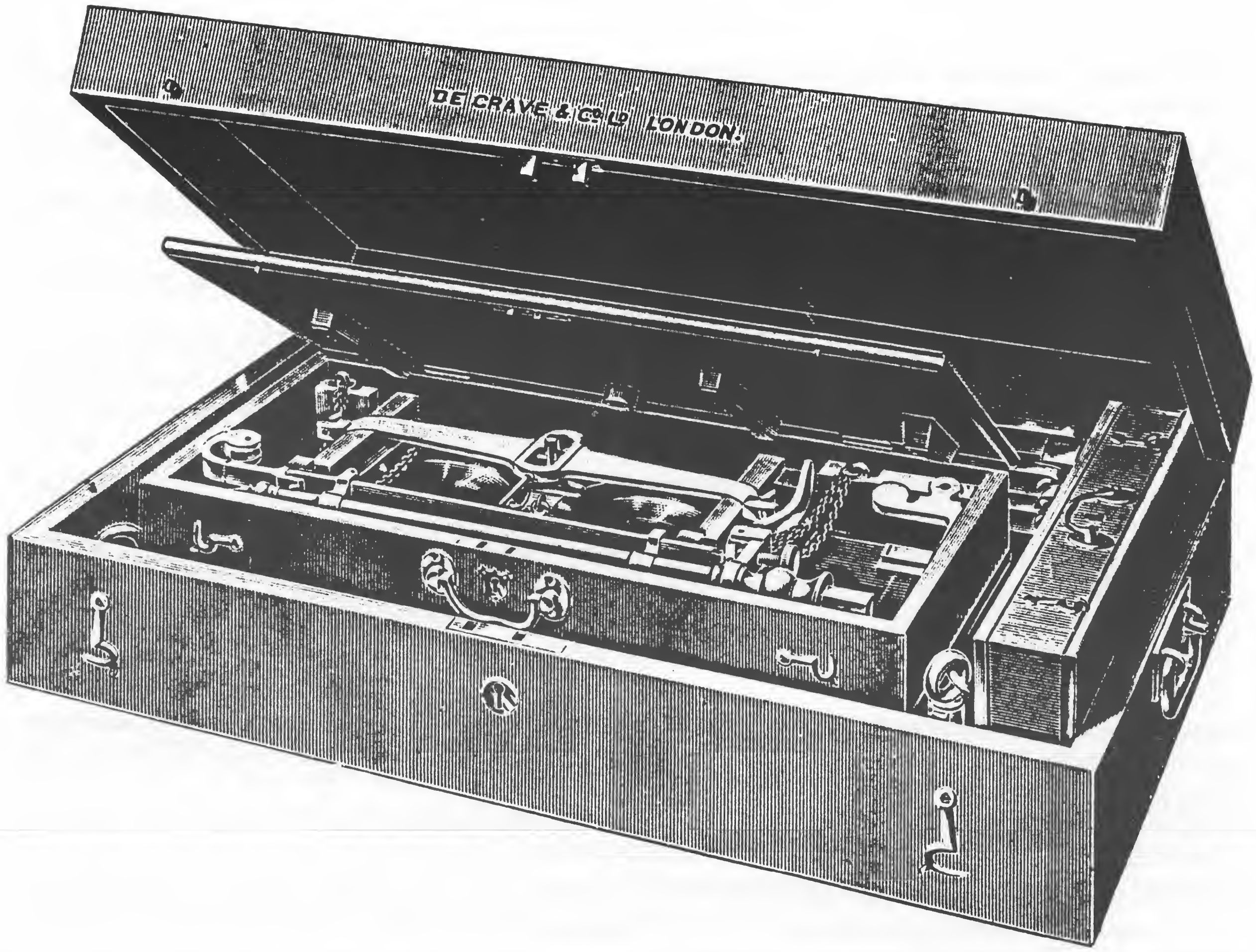


Fig. 1. DeGrave Short & Co, c.1910. *'The above illustration shows three of our patent open shackle beams, sizes 56 lb, 7 lb and 1 lb, beams 24 ins, 14 ins and 8 ins long, as specified by the Standards Department, Board of Trade, for outdoor use. The 1 lb, 8 ins beam is complete with pillar and box etc., as is also the 7 lb, 14 ins beam, and both these boxes are fitted into the chest containing the 56 lb beam, together with folding tripod to suspend same. The three beams etc. form a complete outdoor beam kit for dealing with all weights 56 lb down, and at the same time each size beam is complete in itself and can be used independently.'*

Feature in the construction renders it impossible for the Beam and parts to be put together incorrectly, thereby avoiding the possibility of any variation in weighing. One tripod for this beam was 5 foot (1500 mm) tall and *made of japanned wrought-iron, arranged so that it can readily be taken to pieces and folded up, occupying when packed only a very small space.* Alternatively, they offered a *polished ash tripod with brass fittings and leather carrying strap. This Stand is very light and portable, only weighing about 8 lb. complete.* This last comment makes it clear that Avery's knew that inspectors desired light equipment, but it is difficult to see their compliance with that desire.

It is difficult to imagine how the inspector carried all his gear before the days of motor-vehicles. If he had to take his portable forge with fuel and tongs, soldering irons and lead ladles; his stamping anvil with hammer and chisels; his stamping block with slot to take the handles of Bell and Ring Weights during the process of stamping the Plug on the bottom of the Weights; his verification punches; his branding iron for marking Wood Measures of Capacity with its heating apparatus, and all the other tools necessary, he would need a pony and trap.[1] In a town, perhaps a strong hand-cart would be sufficient, but it was still the equivalent of moving his workshop for every verification session.

Notes and References

1 Perhaps our W & M Inspectors could throw some light onto this, having probably heard reminiscences from their elders and betters when they were beginners.

Fig. 2. Left. DeGrave Short & Co, c.1910, compact folding tripod. Size not specified, but with the 24 ins beam, it must have been 60-66 ins high.

Fig. 3. Right. W & T Avery Ltd, 1897. Standard Avoirdupois Weights 56 lb to ½ dram. ISASC members who attended the LA convention in 1997 will remember the magnificent set belonging to Joe Lenorovitz, for which he needed a trolley.

Review

Instruments of Science: An Historical Encyclopedia, Garland Encyclopedias in the History of Science, volume 2, edited by R Bud and D J Warner, published by the Science Museum, London, the National Museum of American History, Smithsonian Institution, Washington and Garland Publishing Inc, 1998. ISBN 0-8153-1561-9.

When I recently asked the owner of an antique shop if she had any scientific instruments, I received a polite response - *sorry, no*. Yet, on the way out, I noticed a set of weights, a steelyard and a Bunsen burner! Clearly the term *scientific instrument* is very narrowly defined in the minds of some people. How then does an encyclopedia entitled *Instruments of Science* define its subject matter? As the book's introduction notes, in 1876 the physicist James Clerk Maxwell gave the first definition of a scientific instrument as *anything that allows a measurement to be taken.* Thus, for example, an intelligence test would be a scientific instrument.

In fact the *Instruments of Science* encyclopedia does indeed contain the three examples seen in the shop, and then describes over three hundred more. Consequently the book contains over seven hundred pages and, perhaps of interest to ISASC members, weighs 3lb 5oz or nearly 1.5 kg. The encyclopedia is the result of a collaboration between the principal editors - Robert Bud of the Science Museum, London and Deborah Jean Warner of the National Museum of American History, Smithsonian Institute, USA. The book is the second volume in a series dedicated to the history of science. Each volume is independent of the others, although some overlap may occur, and this is almost certain to be the case with this volume because of the wide range of devices considered.

Over the past ten years the two editors and a number of sub-editors have identified those instruments worthy of inclusion, contacted over 230 relevant experts and co-ordinated their descriptions of how a device works, how it was used, who developed it and its importance in science, into a unified whole.

The result is a reference work addressing a long historical period of scientific instrument developments that considers applications as well as portraying some of the beauty and skill that make the antique instruments so collectable. In short, it is an effective, comprehensive, informative and extremely well-illustrated and referenced work of scholarship. It will be valuable to both students and to collectors.

That is the positive side. The negative side is that limited descriptions only are inevitable when attempting to cover so many instruments. ISASC members will be disappointed with the small amount of space allocated to *The Balance*: four pages (excluding illustrations) out of 700. Nevertheless, the contributing experts to this section have produced succinct yet knowledgeable and interesting accounts of three balance themes - the *Chemical Balance*, the *General Balance* and the *Hydrostatic Balance*.

In merely thirteen paragraphs R G W Anderson describes the history of the chemical balance, starting with descriptions of the balance in the Egyptian papyrus *The Book of the Dead* of 1300BC, and finishing with a brief account of the automatic Electro-balance recently developed.

Your editor, D F Crawforth-Hitchins manages, in even fewer paragraphs, to outline the major advances in balances in general. She notes the ever-increasing need for accuracy in weighing as the revolutions in science, in technology and industry gathered momentum during the 18th century. She also indicates the significant developments in scale-making over the past 200 years.

Finally, Peta Buchanan (another ISASC member) gives a brief account - in five paragraphs - of the history of the hydrostatic balance in determining the specific gravity of substances, particularly gases. It was the increased sensitivity of the hydrostatic balance that allowed atomic masses to be accurately determined and thus to open-up the whole topic of atomic theory.

Clearly, you will not turn to this volume for detailed information about specific instruments. Its main virtue lies in the breadth of its coverage, its thirty-six pages of index, its fascinating insights, and its clear illustrations. Anyone interested in a possible instrument of science will gain an immediate, readable and visual introduction to the device and be able to follow up the useful references if they wish to do so.

P HOLROYD

Book

Errors in Practical Measurement in Science, Engineering, and Technology by B Austin Barry, pub. John Wiley & Sons Inc, New York, Chichester, Brisbane & Toronto, 1978. ISBN 0-471-03156-9.

To quote the dust-cover, this book relates accuracy to precision; tells how to compare different sets of measurements of the same quantity; shows that repeated measurements can approach true value; introduces the concept of percentage compliance with a demand specification; discusses practical plotting of frequency distribution curve to observe conformity to normal distribution in a 'quick-and-dirty' manner; offers tables of areas beneath normal curve to assist in formulating the validity of measurements - to give the percent assurance of being true; examines the value of adherence to specified procedures to maintain reliability in measurements; and provides basic information of the probability ellipse for two-dimensional errors.

Because of its title, members might buy it, but this book could be sub-titled *Mathematical methods needed by engineers to evaluate measurements*. It is highly technical, full of mathematical formulae and examples of their use, and probably needed only by engineers learning their subject.

D F C-H

A Mystery Solved

BY B WRIGHT

The Small Metal Clip Did It.

Collectors of American Counterfeit coin detectors [ccds] have long puzzled over how to use the graduations for letter-weighing added to later versions of the coin-rocker patented by J A Thompson.[1]

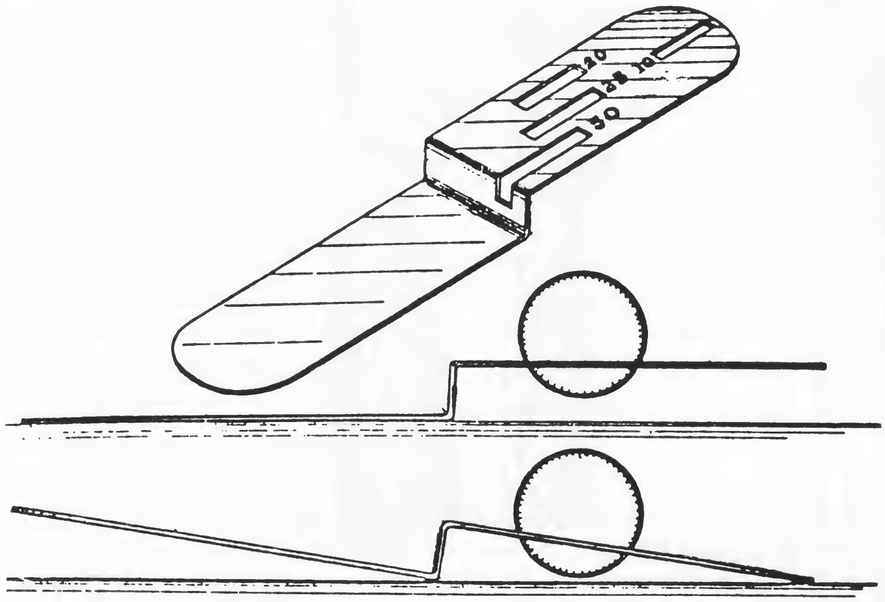


Fig. 1. Patent 187,936 of John A Thompson of Chicago, originally designed for silver coins although Thompson stated in the specification *'may contain a slot for any coins, United States or foreign, silver or gold....when a counterfeit coin is placed in the slot it is immediately detected by its light weight in not tipping the balance, or its greater bulk in filling the slot, as the spurious metal, as is well-known, is almost invariably lighter than the genuine, and the coin must therefore be necessarily lighter or larger.'*

The original design, U.S. patent no. 187,936,[2] on 28 February 1882, was for a flat metal strip with a centre bent at a right-angle to form a fulcrum. See fig. 1. The patent illustration shows, at one end of the rocker, four longitudinal slots for testing the weight and thickness of ten, twenty, twenty-five and fifty cent silver coins. The first example made by the Berrian M'f'g Co. of New York, had added longitudinal slots for \$5 and \$3 with crosswise drop-through slots for testing thickness and diameter of the same coins.

Advertised as *The simplest, best and most reliable in the market*, the rocker sold wholesale for \$7.50 per dozen or \$1 each.

On a later version four horizontal lines marked for weighing letters of ½, 1, 1½ and 2 oz were placed across the \$1 weight-testing slot. These lines were the source of the current mystery. No one was sure how to use them.

The mystery has been solved by the finding of a later Berrian in the original box containing the original two-pages of instructions. The first page gives directions for using the coin-slots. The second has an illustration of the rocker in use for weighing a letter. The letter was held by a small metal clip, probably of blued-steel. The clip, pressed together between the thumb and fore-finger, was

Fig. 2. Although made of a sheet of brass, nickelled, the letters are so finely stamped that it gives the impression of a very nicely made, high-quality balance. Photo B Wright

TWO MEDALS

OF

EXCELLENCE

AWARDED BY

AMERICAN INSTITUTE.

BERRIAN MANUFACTURING CO.'S

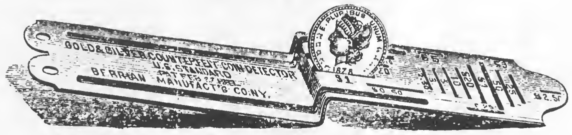
PATENT GOLD AND SILVER

Counterfeit Coin Detector,

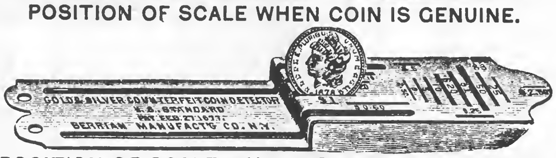
U. S. STANDARD.

A Sure Protection against Fraud.

LENGTH, 9 INCHES.



POSITION OF SCALE WHEN COIN IS GENUINE.



POSITION OF SCALE WHEN COIN IS COUNTERFEIT.

The simplest, best and most reliable in the market. Being less complicated, and not liable to get out of order, it is far superior to all others.

It is a perfect scale, and weighs with the nicest accuracy, and gives the exact thickness and diameter of all the principal U. S. Gold and Silver Coins, viz.: the Silver Dollar, quarter and half dollar; also the \$20, \$10, \$5, \$3, \$2½, and \$1 gold coins, thus detecting the counterfeit at once. No person can be defrauded who uses this detector. It is constructed on scientific principles, yet so simple that all can understand it at a glance, and no handling can affect its action It is manufactured of brass, heavily nickle plated, highly finished, and is a perfect gem, worth four times its cost. It is indispensable to all handling gold and silver coins, an article of real merit, and warranted accurate. No person in business can afford to be without it.

DIRECTIONS. -Place the scale on a level surface, and insert the coin in the slot in the beam corresponding with the denomination of the coin to be tested. If the beam falls it is good as to weight, then pass the coin to the corresponding cross slot, if the coin passes through it is good. If the coin does not stand these tests, it is worthless.

☞ To test the weight of the Gold Dollar, place a 25-cent coin in the \$5.00 gold cross or measuring slot, and *lay* the gold dollar against it in front, if good the scale will fall.

N. B.—Old United States Gold and Silver coins are larger in diameter than than those of more recent coinage, particularly silver half dollars from 1836 to 1850, therefore, though weighing correctly, will not pass through the measuring slots. do not reject them on this account.

Will send sample in neat box, by mail, upon receipt of price, \$1.00

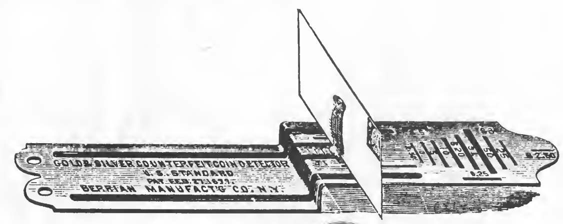
BERRIAN MANUFACTURING CO.'S

PATENT GOLD AND SILVER COUNTERFEIT

COIN DETECTOR AND LETTER SCALE COMBINED,

SIMPLEST, CHEAPEST AND BEST.

An article universally needed by all Banks, Storekeepers and others handling gold or silver coin, it is made of brass, heavily nickle plated, elegantly finished, and warranted accurate. It cannot get out of order, as there are no pivots or intricate mechanism and both in detecting counterfeit Coins and weighing Letters, a child can use it as well as an expert with equal safety. Owing to the formation of the Detector they can be packed in boxes of one dozen each, measuring ten inches in length, three inches in width and one inch in depth, thus making the package convenient for agents to canvass with.



Place the Attachment in the dollar slot of the scale, and press the sides into the hollow near the base with the thumb and finger, which will allow it to go into the slot easily, then turn it half way around and insert the letter as shown in the above cut. The attachment can be moved backward and forward as desired, the centre points being the indicators, and when immediately over the mark on each side of the slot, will indicate the amount of postage required; if on the half oz mark and the letter does not weigh down the scale, but one stamp is required, and so on according to weight indicated; the rate being one stamp for every half ounce.

Liberal Discount to Agents and the Trade.

Since the reduction in postage the letter weights are seldom called for.

Fig. 3. The instructions supplied with the Berrian Manufacturing Co.'s counterfeit coin detector.

inserted in the $1 slot and pushed towards or away from the fulcrum until the clip was precisely on the line of the proper weight indication. Presumably the user started with the clip over the lightestest graduation, ½ oz, and if the rocker did not tip, one stamp of 2¢ was applied to the letter. If the rocker tipped, the user twisted the clip through 90° to loosen it, the clip was slipped along the $1 slot towards the fulcrum to the position directly above the 1oz graduation, the user twisted the clip to lock it in position, and, if the letter did not tip the rocker, applied two 2¢ stamps.

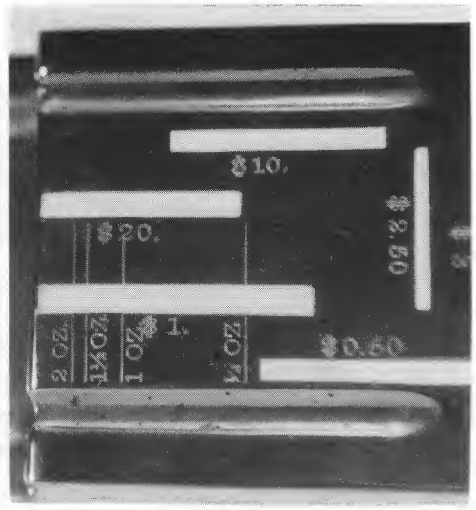


Fig. 4. The author's example shows the fine lines drawn across the slot for $1 silver. The slots are accurately cut so the ccd will indicate a coin which has only a minute loss of gold or silver, or a small addition of base metal.

In a display of honesty not usually associated with early advertisements, there is a line which cautions, "*Since the reduction in postage the letter weights are seldom called for*." This implies a date for this piece of 1885 when U.S. postal rates had been reduced from 2¢ per ½ ounce to 2¢ per ounce, confirmed by the illustration on the instruction sheet of The Medal of Excellence of the American Institute, New York, awarded to Berrian M'f'g Co. in 1884.

Author's Biography

Betty Wright had been collecting scales for ten years before meeting another collector. A London antique-dealer told her of the formation of a society for scale collectors and she became a Charter Member of ISASC. She lives in the Old Town section of Alexandria, Virginia, battling against the natural aging processes of an old house and tending her beautiful old-world garden. Her professional career has been in the field of magazine publishing, writing, and editing.

Notes and References

1 Editor - This query was first raised by Eric Newman in 1987, EQM p 848, so it is especially satisfying to receive an answer.

2 Thompson, J A, invented three ccds, of which this is the earliest. See EQM p 840, 876 and 931.

Comment on Pitrat

S CHAPMAN

The comments in the article on Pitrat, EQM 2232, relating to his experience of mechanics while working as a silk-weaver in France, echo similar thoughts that have arisen while studying the development of long-case clocks (*grandfather clocks* in common parlance) in England. These clocks were particularly popular in textile-processing areas, and the local clock-makers were thinking of new ways to circumvent problems, in the same areas of England as textiles were being woven and knitted during the second half of the 17th century.

What was the reason for this correlation? Apart from the relative prosperity of the workers, could it be that the stocking frame-knitters had become accustomed to the 2000 steel working parts of the frame, and were able to transfer their knowledge of technology to clock-making? Could Pitrat have similarly transferred his understanding of the weaving technology of the Jacquard loom to the computing scale?

Author's biography

Professor Chapman edits a journal of Textile History, producing 120 pages twice a year with the assistance of his wife, and has an interest in metal antiques.

Emendation by the sub-editor

EQM, p 2234. The 1886 patent is no <u>341,166</u> Apologies from the editor.

Apology

The Cover Picture on EQM, p 2225, was of superb quality, and was intended to enhance the Cover of the last issue of our magazine. Due to a misunderstanding, the shadows were trimmed down but not eliminated, leaving fuzzy edges round the box. We apologise to the members and to Christies Auction-house.

Alex Bernstein's Patent Coin Tester

Part 1

BY J LINDNER

Introduction

At the April meeting in 1875 of the *Verein zur Beförderung des Gewerbefleißes in Preußen*[1] Prof. Reuleaux, the director of the Königl. Gewerbe-akademie Berlin, demonstrated *a model of a gold-scale, sent in by Mr. Köllner of this town* [Berlin], *by which the correct weight and size of the new Reichsgold-coins (Crowns and Double-crowns) can be tested easily and quickly.* The gold-scale was probably one of the first counterfeit coin detectors for Reichsgold coins, because only four months before, on 1st January, 1875, the exclusive use of the Reichsmark was introduced,[2] and it is hardly possible that there were already many counterfeits of the new Ten and Twenty Mark pieces.

The gold-scale shown at the meeting was presumably one of the rocker types, because by using the gold balances in use in Germany until then, one could check only the weight, but not the size of coins. Regrettably nothing was said about the appearance of the scale. It could have been a rocker imported from England (bottom of fig. 2) where they had been produced in great quantities since about 1828 for Sovereigns and Half-sovereigns,[3] or it could have been one of the first CCDs made by Ph J Maul in Hamburg (top of Fig. 2).[4]

Fig. 1. Alex Bernstein & Co of Berlin, gold money rocker for 10 & 20 Mark pieces.

But it is more probable that it was a CCD made by the engineer **A Bernstein** from Berlin, who had been a member of the *Verein zur Beförderung des Gewerbefleißes in Preußen* since 1st January 1873, and because one could test only the weight and diameter of the new Reichsgold coins but not their thickness, as could be checked by both the *Reichsgold-rockers* shown in fig. 1. It must have been one of the first versions by Alex Bernstein, probably without his name on, because otherwise Prof. Reuleaux would not have omitted his name.

The gold scale by Alex Bernstein is not like the two CCDs shown above, except that it is also a rocker. But it must be assumed that Alex invented it without knowing the English rocker-types, because his were more similar to the earlier coin-scales, which had the beam suspended in shears with a tassel for holding. Also he applied for patents in England and France (see the section on The Patent Gold-testers below) whereas he would not have done so, had he realised that rockers had already been used in England for the previous fifty years.

The CCD of Alex Bernstein can be held free-swinging in one hand (fig. 3) and the beam is horizontal if the coins are current weight. As the human eye can estimate a right-angle very accurately, it is easy, theoretically at least, to recognise whether the coins are current weight or whether they are lighter or heavier. But this tester has the usual inaccuracy associated with rockers: because, by turning the coin in the recess, the centre of gravity is varying distances from the fulcrum by reason of the unequal distribution of the mass of the decorative design. Consequently the centre of the coin is not synonymous with the centre of gravity, and precise weighing is not practicable with these gold-coin testers. But for checking the genuineness of gold coins, they are fully sufficient, because the counterfeit coins were not made of noble metal, and because of the considerable differences in their density, they were substantially lighter, if the dimensions were correct, or are much thicker or larger, if the weight was correct.

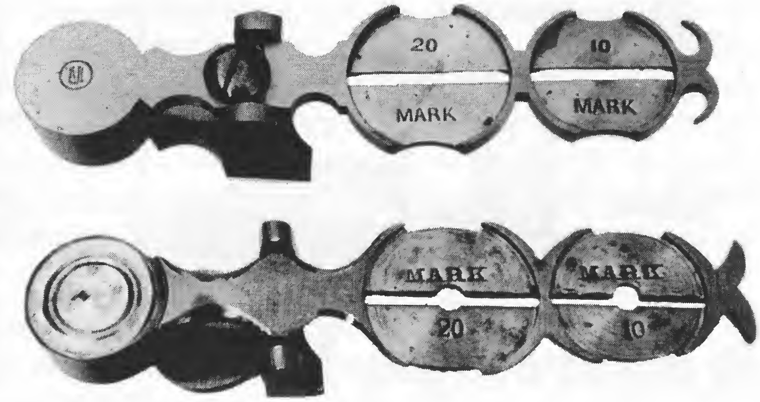


Fig. 2. Reichsgold-rocker. Top, Ph J Maul rocker. Bottom, English rocker imported into Germany after 1 Jan 1875.

The CCDs of Alex Bernstein are desirable collectibles today and presumably the last material evidence of a man, his life and work. Let us pursue him through the evidence of his applications for over 120 patents over a forty year span. Although he applied for only four patents for weighing instruments, (two for this gold-scale and two for a weigh-bridge) his interesting and varied way of life will be described to give a perspective to the value of the memorial of his CCDs.

The Factory for Weighing Machines, Alex Bernstein (& Co., Nachf., etc.)

On 18th November 1871, the firm **Alex Bernstein** was registered as *merchant* Alex Bernstein (present business premises: Blumenstrasse 37).[5] In the Directory of Berlin for the year 1873 it appears for the first time as *Mechanical Engineering-institution and factory for weighing machines*. On the occasion of the founding of his factory Alex Bernstein printed pink-coloured price-lists of four pages.[6] The front and the back pages are in fig. 4.

Apparently for reasons of finance, Alex Bernstein changed his firm into a trading company on 1st March 1873, which was registered with the new name **Alex Bernstein & Co.**[7] The partners were *the engineer Alex Bernstein and the merchant Alex Nathan*. In the Directory of Berlin of 1874, Alex Nathan was designated *manufacturer dwelling at Schützenstraße 15*; in 1873 he was designated at the same address as *pawnbroker*. From 1874 to 1876 the firm was described as *Factory for Weighing-machines, Blumenstraße 37, head-office and depot*

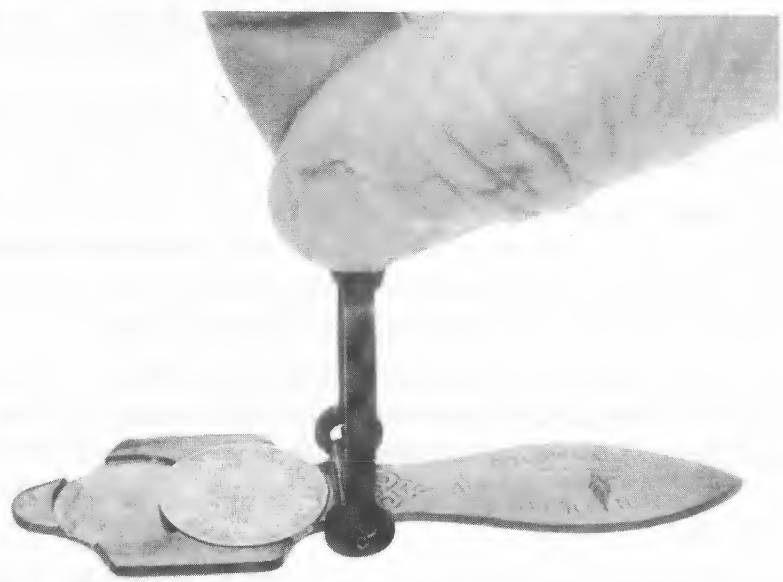
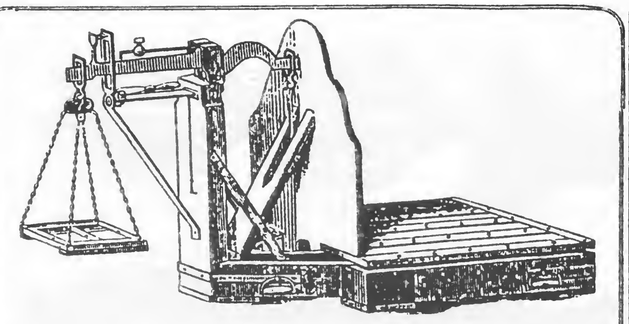


Fig. 3. Compare with fig. 5. Note the different pattern stamped on the beam, and the lack of dust-caps.



Die

Brückenwaagen-Fabrik

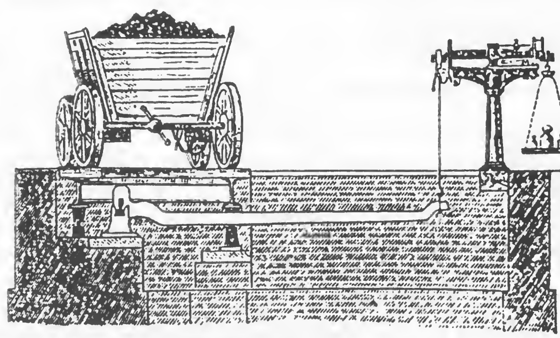
von

Alex Bernstein,

Berlin,

Blumenstrasse 37,

empfiehlt ihr Lager von hölzernen u. eisernen **Decimalwaagen; Centesimalwaagen** von 100—1000 Ctr. Tragfähigkeit; Aichungsfähigen **Schnellwaagen, Viehwaagen Karrenwaagen etc.**



Vergleichungs-Tabelle

der

neuen und alten Gewichte.

1 Ctr.	=	50 Kilogramm.						
2 Pfd.	=	1 Kilo	=	1000 Gramm.				
1 Pfd.	=	$^1/_2$ Kilo	=	500 Gramm	=	50 neu Loth.		
$^1/_2$ Pfd.	=	15 alt Loth	=	250 Gramm	=	25 neu Loth.		
		10 „ „	=	$166^2/_3$ „	=	$16^2/_3$ „ „		
		5 „ „	=	$83^1/_3$ „	=	$8^1/_3$ „ „		
		3 „ „	=	50 „	=	5 „ „		
		2 „ „	=	$33^1/_3$ „	=	$3^1/_3$ „ „		
		1 „ „	=	$16^2/_3$ „	=	$1^2/_3$ „ „		

1 Pfd. = 50 neu Loth.
1 neu Loth = 10 Gramm.

Gramm.		altes Gewicht.		neues Gewicht.
500	=	1 Pfd.	=	1 Pfd.
250	=	$^1/_2$ „	=	25 neu Loth.
200	=	12 Loth	=	20 „ „
100	=	6 „	=	10 „ „
50	=	3 „	=	5 „ „
20	=	1 Loth 3 Quent.	=	2 „ „
10	=	6 „	=	1 „ „
5	=	3 „	=	$^1/_2$ „ „
2	=	$1^2/_{10}$ „	=	$^1/_4$ „ „
1	=	$^6/_{10}$ „	=	$^1/_{10}$ „ „

Die Anwendung folgender Gewichtsstücke ist vom 1. Januar 1872 ungesetzlich. $^1/_4$ Ctr., 3 Pfd., 10 Loth, $^1/_4$ Pfd., 5 Loth, 2 Loth, 1 Loth und die Unterabtheilungen.

Ueber die Anwendung der **Waagen** bestimmt das Gesetz, dass sämmtliche Waagen, welche mit dem preussischen Stempel versehen sind, von Neuem geaicht werden müssen. Zu diesem Zwecke bedürfen die Waagen einer vorausgegangenen Reparatur, welche auf dem Aichungsamt nicht ausgeführt werden kann. Die **Reparatur** und **Aichung** solcher Waagen besorgt die

Brückenwaagen-Fabrik von Alex Bernstein,

Blumenstrasse 37.

Fig. 4. Price-list published November 1871 (reduced to 80%). Note that Bernstein included platform scales, decimal scales, centesimal scales, steelyards, cart scales, etc. He assumed that customers still thought in the old pre-decimal units of pfunds and loths and might need conversion tables. Another complication was that the type of loth had to be specified, because three old loths equalled five new loths, to bring the new loths into direct comparison with grams, (that is, that 20 new loths equalled 200 grams and 5 new loths equalled 50 grams). This price-list was printed before the compulsory introduction of the metric system in Germany on 1.1.1872. Therefore this price-list was valid for the period both before and after the introduction of the metric system. Kaiserliche Normal Eichungs Kommission Berlin

Markgrafenstraße 50, and in 1877, *Factory for Weighing-machines and Mechanical Engineering-institution, W [Berlin], Markgrafenstraße 50, factory NW Lehrter Straße, 16 and 17.*

The trading company was dissolved by mutual agreement on 15th January 1878, and the firm was continued by the merchant Alex Nathan alone under the unchanged name **Alex Bernstein & Co.**[8] Alex Nathan moved meanwhile to Markgrafenstraße 50. In 1878 he was designated as sole owner. (It is possible that Alex Bernstein was still a sleeping partner.)

The firm's name was altered on 14th February 1880, to *Alex Bernstein & Co, Nachf. [Owner] A Nathan.*[9] In the directories of Berlin for 1880 to 1882, the firm is described as *Special: Factory for platform and table scales, etc, Markgrafenstraße 50, Berlin W, factory: C Kurstr. 34 & 35.* Probably Alex Bernstein had been involved, but he definitely opted out of the firm he started, as in 1880 he went to the USA.

By agreement the ownership of the firm devolved on 30th March 1882 onto the merchant Friedrich Eugen Bierstedt with the new firm named **Alex Bernstein & Co Nachf. E Bierstedt.**[10] The firm was

recorded in the directories for 1883 at Markgrafenstraße 50, but the factory was at Berlin N, Ackerstraße 155, and annotated *Factory for weighing machines, specially for all sorts of scales, balances and table scales, letter and gold scales, decimal and centesimal scales, scales for animals.* ***Inventor of the first gold and silver coin tester***. This assortment appeared in the subsequent directories until 1898, supplemented by *child and person scales, analytical balances, counter and kitchen scales, newest little machines for house and kitchen*, with minor variations. The merchant Eugen Bierstedt and his action (to have nullified the German patent no. 299 of August Reitze) has been mentioned twice in EQM.[11]

On 1st July 1883 two new partners joined the firm, the merchant Hermann Gustav Ackermann and the engineer Heinrich Friedrich Dopp, both of Berlin and the firm was registered as a general partnership. Its new and final name, lasting until its expiry in 1923, was now **Alex Bernstein & Co Nachf**.[12] Dopp was owner of a weighing-machine factory at Berlin N, Eichendorffstr. 20, and a member of the City Council, and Ackermann was confidential clerk in the firm of Dopp. The merchant E Bierstedt retired from the company on 25th October 1884,[13] after the legal right to represent the company had been taken from him three weeks earlier.

On 23rd September 1889, the company was dissolved and restarted by the factory-owner Heinrich Friedrich Dopp alone without changing the name, (the partnership of Ackermann having already expired on 25th May 1889).[14] [15] From 1888 the firm was recorded in the directories of Berlin at: *Office, Eichendorffstr 20., N* [Berlin], *sales depot, Markgrafenstr 50., W*, and from 1899 to 1921 the whole record was still only *Alex Bernstein & Co. Nachf., weighing-machine factory, N Eichendorffst 20, Owner F Dopp*. And the final addresses found in the directories of Berlin for 1922 and 1923 were: *Berlin-Frohnau, Markgrafenstr. 1, Ecke Göbenstrasse,* and *Baustelle Naehlersches Haus, Markgrafen-str.* [Frohnau]. The firm was eliminated from the Commercial Register of Berlin on 3 January 1923.[16]

The Engineer Alex Bernstein

Whereas the name of Alex Bernstein's father, Aaron David Bernstein, is still in the literature and in encyclopaedias etc., (his *Apparatus for Sorting Coins* being described in EQM[17]), hardly any notice has been accorded to his son, Alex, because he did not play an important part in policy-making or in literature. Also, Alex did not influence technical developments so very much, to the point where his name might be mentioned in modern technical literature, but everywhere there are traces of him, and whenever the *engineer Alex Bernstein* was mentioned before the First World War, then it was always "our" Alex. So the weighing-machine factory founded by him in 1871 continued to bear his name until 1923, and 40 years of his life can be reconstructed from his innumerable patent applications in all parts of the world. Although the patent lists available were incomplete (for example, US ones only up to 1883, and UK ones only to 1888) 121 applications were found (it is not relevant to this report to identify which were granted). As the patent lists often gave name, job and address, many additional details could be verified in archives, directories, libraries, etc.

Alex Bernstein was the fourth child and the second son of Aaron David Bernstein's seven children. He was born on 20th September 1843 in Berlin and was named **Alexis**.[18] Even as a child his family usually called him Alex,[19] [20] and he called himself **Alex** throughout his life in business. In later years he was sometimes called Alexander because people assumed that Alexander was his complete first name, and he occasionally used the name himself. Only in official documents was his correct first name used, **Alexis**.

Until his 28th year of life, almost all traces of him are lost, and only in the memoirs of his sister Johanna[19] and his brother Julius[20] was he mentioned several times. From them we know about his abbreviated name, Alex, his technical interests and that he probably got his engineering education at the

Kgl. Gewerbe-Institut in Berlin, (later called the *Gewerbe-Akademie*). By recommendation of the Director of this Institute, Nottebohm, he could have been accepted as a member of the *Verein zur Beförderung des Gewerbefleißes in Preußen* on 1st January 1873, where Prof. Reuleaux reported about the gold-scale in April 1875.[1]

After his education, Alex was possibly in the USA, as a US patent by *Alexander Bernstein of Brooklyn, NY, for a machine for manufacturing chenille* was recorded on 21st July 1868. This is a reasonable assumption, because no other Alexander Bernstein had any patents prior to 1883 in the USA.

Alex Bernstein's name appeared for the first time in the publicity on 18th November 1871, on the occasion of the registration of the firm **Alex Bernstein**. In the directory *Allgemeiner Wohnungsanzeiger für Berlin* for 1872, he was recorded for the first time as *Manufacturer of weigh-bridges, Blumenstraße 37*, (see fig. 4). At that time, 1872/1873, came his first two inventions. One was for an *electro-pneumatic contact alarm for signalling the passage of a railway train at a given spot*, and the second was an *apparatus for controlling switches and siding-rails*. Both inventions were granted to him in Baden, Bavaria, Belgium, France, Great Britain and Ireland, Austria, Saxony and the USA, in which patents he was called *engineer from Chemnitz* in Saxony and Bavaria, and in all other countries as *engineer* or as *manufacturer from Berlin*. The first invention is presumably the invention that was attributed in almost all biographies to his father, Aaron David Bernstein, as an invention for an *automatic safeguard for railway crossings*.[17]

Whereas in 1872 his private address was still that of his firm Blumenstraße 37, Alex Bernstein changed his home address every year until 1877, under the designation *manufacturer*, in the Berlin directories. During this time he applied for several very varied patents, amongst them in Bavaria (25.11.1874) and Saxony (24.8.1874) an invention for *a decimal lever balance with index*.[21] Two years later came the applications for a patent for his coin-tester in UK (23.12.1876) and in France (3.1.1877). Of the innumerable patent applications by Alex Bernstein, only these four related to scales. (See p 2277.)

After his retirement on 15th January 1878,[8] from the firm he founded in Berlin in 1871, Alex Bernstein was active until 1880 as a free-lance civil-engineer, with an office on Berlin SW, Leipziger Str. 83, and living at Berlin W, Genthiner Str. 13. During this time he applied for a patent for *an apparatus for testing highly inflammable liquids* in the following countries: Germany, Great Britain and Ireland, Belgium, Austria and USA. No contact with his former firm was traced after 1878.

In July 1880, Alex Bernstein lectured to a meeting of the *Verein zur Beförderung des Gewerbefleißes* about the actual state of telephonic communications,[22] and from then on, he was mainly engaged in problems relating to electricity. Lasting evidence of him in Germany was the publication in 1880 of his book *Die Electrische Beleuchtung*,[23] in which he described in non-technical language, the generation of electricity and the electric carbon light. That was the year that he went to the USA.

From 1881 to 1891, he can be traced through 57 patent applications from Boston, via London, to Hamburg. These applications related almost exclusively to electric incandescent lamps and electrical apparatus (switches, dynamo machines, galvanic gas batteries, etc.) He applied for 13 patents in USA (up to 1883), 15 in Great Britain (up to 1888), 15 in France, 10 in Germany, one in Austria, one in Belgium and two in the Swiss Confederation. In the lists of patents from 1881 to 1884 (25 in all) he was called *Alex* (or *Alexander*) *Bernstein of Boston, in the county of Suffolk and State of Massachusetts, USA*, and from 1883, sometimes with the addition of *Assignor to the Bernstein Electric Light Manufacturing Company*. He had founded this company in Boston in 1883; in the directories of Boston this company was listed from 1883 until 1904. It produced incandescent lamps and dynamos or generators, according to the patents of Alexander Bernstein and in accordance with *Bernstein's*

Lighting-System. *Alexis Bernstein* is listed in the Boston directories from 1883 to 1885 as residing at the Commonwealth Hotel.[24] He left Boston in 1884[19] and went to London, where he lived until 1888, busy with his electrical studies, during which time he applied for 25 more patents, and lectured on his Lighting-System. This system was reported in several technical journals.[25] His addresses in London, according to the patents, were *9A Commercial Road, Pimlico, Middlesex* and *4 South Street, Finsbury, London.*

Leaving London, Alex Bernstein arrived in Hamburg in August, 1888, where he registered as a self-employed engineer at the Registration Office under his correct first name, *Alexis*. Alexis resided until January 1894 in Hamburg and moved house 8 times while there. Probably he was renting, because he only twice appeared in directories of Hamburg. On the 6th September 1888, he started a new enterprise for *manufacturing apparatus for electrical lighting*.[26] The address of the factory was, according to the directory for 1890, *am Mühlenkamp*, and his residence as *Mühlenkamp 39*.

Then on 27th February 1890 the meeting took place for the foundation of the *Bernstein's Electricititätswerke Kommandit-Gesellschaft* in Hamburg at Mühlenkamp,.[27] There were 16 limited partners with shares of 50,000 Marks each. Alexis Bernstein was the personally responsible partner. In 1891 the address of the company is recorded as Dorotheenstraße 84/90. Presumably Alexis Bernstein intended to build a power-station for a part of Hamburg, providing lamps, generators and his *Lighting-System*. But, unfortunately, the universal power supply for Hamburg was established at the same time,[28] so Bernstein's limited company went into liquidation on 15.10.1891, and was blotted out of the Commercial Register of Hamburg on 8.10.1894.[27]

A petition for admittance to the *Hamburgische Staatsverband* was filed in December 1890, and citizenship was conferred on 9.1.1891,[29] which he retained until his death.[30] Up to 1891, Alexis Bernstein filed 9 applications for patents relating to lamps and dynamos, but during his residence in Hamburg he developed a new enthusiasm, for milk. This resulted in two applications for patents in Germany and France for a procedure to *homogenise fresh milk*.

Alexis Bernstein gave notice of his departure from Hamburg to his home town, Berlin to the Registration Office on 19.1.1894.[18] Apparently Alexis Bernstein changed his residence in Berlin frequently, and was a tenant, as he was seldom found in the Berlin directories, but he was at Magdeburger Str. 9 from 1902 to 1912. Between 1894 and 1909 he made 24 applications for patents (in Germany, France, Austria and Belgium) which all related to milk-products (for example, casein) and for machines for their manufacture. He also published a book *Die Milch*.[31]

Finally, Alex changed direction once more to a new subject, the manufacturing of rayon, for which he applied for another four inventions. The last patent granted to him was a German patent for *a procedure for manufacturing casein glues*. He applied for it with his son, Dr. Arnold Bernstein, on 29.1.1913, and his place of residence was recorded as Chemnitz, (as was his first patent in 1872). Alexis moved on 15.1.1912 simultaneously with the family of his son Arnold, to Chemnitz, where he died on 8.9.1914.[30]

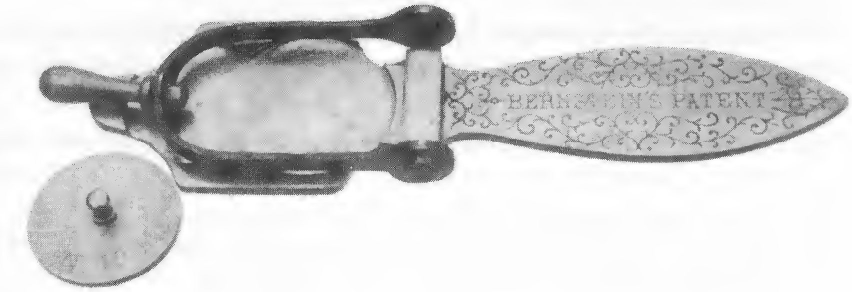


Fig. 5. The standard model stamped BERNSTEIN'S PATENT, made of lacquered brass, with a central rectangle of steel filed to knife-edges and soldered onto the brass, black-enamelled iron shears with dust caps folded round the bottom of the shears, and a brass elongated knob held onto the shears by a nut beneath the shears.

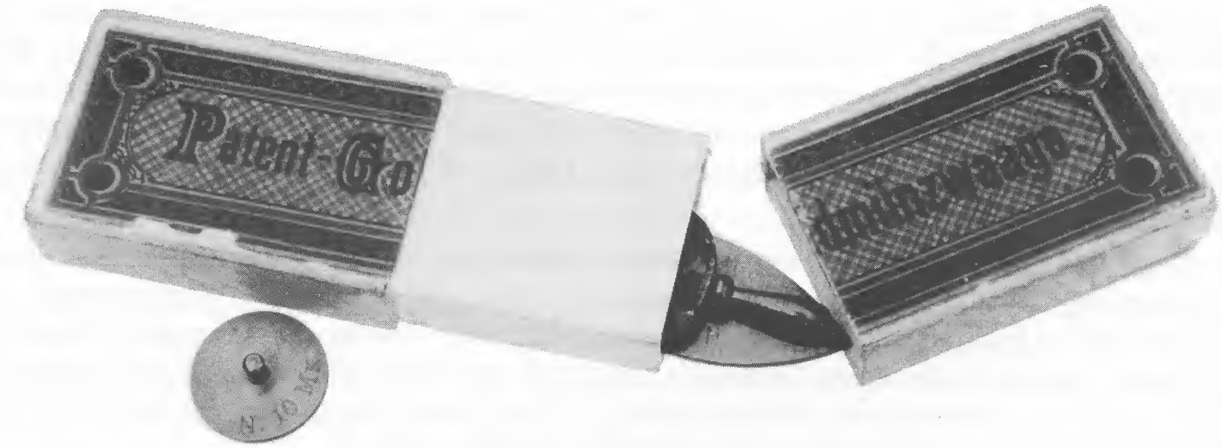


Fig. 6. Box of the standard model. The tartan pattern is in red over golden-yellow, and the main part of the box is white. Other examples had blood-red paper over the main part of the box and duck-egg green paper on the part of the box covered by the cap. Box, $4^1/_8$ x $1^1/4$ x $^1/_2$ ins (107 x 35 x 14 mm).

The Patent Gold-coin Testers

Alex Bernstein produced his gold-coin testers in his weighing-machine factory, apparently beginning in about 1875, in considerable numbers, many of which have survived to the delight of both coin collectors and scale collectors. Certainly they met the approval of the public because they were cheap and compact to carry in the pocket. Alex called them **BERNSTEIN'S PATENT** (see fig.5) to point out the originality of his construction. But this did not mean that he had a patent, only that it was a practical idea. Alex never applied for a patent for his CCD in Germany, but the use of the term *patent* was not restricted until the application of the German Law of Patents on 1.7.1877.

With the CCD came a coin-weight for 10 Marks, to check the beam. These weights have usually got lost nowadays. See fig. 5.

The gold-coin testers came in small pasteboard cap-end boxes. They were covered with coloured linen, imitation shagreen or with white moiré paper, (see fig. 6), and the labels always had the same, very distinctive pattern (compare fig. 6 and fig. 15, to be in the next issue).

In the box was a small label with short directions for use.

Gebrauche-Anweisung	Directions for Use
Man lege das zu wiegende Goldstück in die für das selbe passende Ausbohrung und halte die Waage an dem Messingstiftchen, so dass dieselbe frei spielt. Schlägt die Waage mit der Seite, auf welcher das Goldstück liegt nach oben, so ist dasselbe zu leicht.	Put the gold piece to be weighed in the recess for that coin and hold the scales by the little knob, so that the scale swings freely. If that end of the beam holding the coin tips upwards, then the coin is too light.

Part 2 will be in the next issue.

Notes and References

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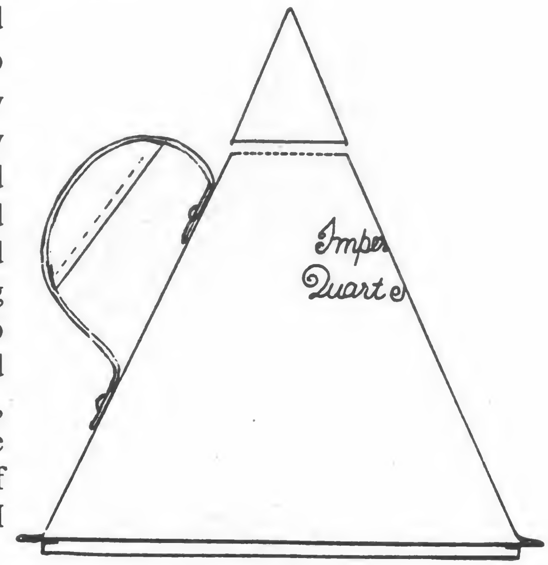
Response to Bate

From J DOUGLAS

The *Contemporary Comment, 1825*, EQM p 2250-2252, may have resolved a problem for me. I bought a quart measure that had with it a conical object of no known use, but having a friend who had, on a separate occasion, bought a measure with a similar cone, I presumed that my measure had the cone for a reason. Seeing *The Bushel made of such figure and dimensions as to represent both the corn and heaped measure accompanied by a gauge, determining the height of the cone in the latter,* I now suspect that I have the gauge for determining heaped measure, although I cannot work out how it functioned.

The sketch is drawn in the correct proportions, the base of the measure being 164mm across, with the folded rim extending out a further 10mm. The height of the measure is 126mm, with the foot ridge raising it another 5mm. The opening is 40mm across, exactly the same diameter as the

"gauge" shown above it. The measure has engraved across its front *Imperial Quart Measure*, but it has no verification marks of any sort. The sheet brass is very thick for such a relatively small measure, and is very golden. The sheet for the measure is rolled round and seamed down the side. The bottom of the cone is turned out to form a lip, round which the base is folded and soldered. The foot is formed by flat sheet folded along its middle line, curved round into a circle and soldered to the base. The handle is flat sheet with rolled and flattened edges, curved round and held by domed rivets, two at the top and one at the bottom, along the line of the seam. The curved sheet soldered to the inner surface of the handle to give a more comfortable grip is a style I associate with the late 19th century.



The "gauge" is made from similar sheet, rolled round and brazed into a cone, with a base soldered in to make an enclosed cone. The "gauge" is 44mm high. If a heap of corn was built above the rim of the measure, it could not possibly achieve the height of my "gauge" without the higher corn sliding off the heap. This deepens the mystery. Is it co-incidence that both my friend and I have these little cones? What is their function?

The Act of Parliament 4 & 5 Gulielmi IV, 1834, IV, stated that *And whereas the Heaped Measure is liable to considerable Variation, and the Use of Weights made of soft Materials affords Facilities to Fraud; be it therefore enacted, That from and after this First Day of January, 1835 so much of the said recited Acts as relate to the Heaped Measure shall be and are hereby repealed, and that the Use of the Heaped Measure shall be abolished, and that all Bargains, Sales, and Contracts made by the Heaped measure after the said First Day of January, 1835 shall be null and void; and thereafter no Weight made of Lead or of Pewter shall be stamped or used.*

Thus my measure would have had a short life as a test for heaped measure if it had originally been intended for trade use, having been made after the Imperial Standard was introduced in 1824 and before it was made illegal in 1835. Of course, in non-trading situations, maybe heaped measure was used, although it is difficult to think of a farmer disposing of a field of corn by any method that was not a "bargain, sale or contract".

Another interesting point in the original article is the water weights supplied with the best set, but not with the Second Set. If the inspector found it useful to have a weight the exact equivalent of the water that would fill the measure, why did he not need such a weight with the Second Set? Would he use two weights from his avoirdupois set? Exact methods of testing were not a matter that aroused much interest in 1825. [It was only in the Schedule to the 1907 Regulations that it was stated that each weight had to be checked against a weight of exactly the same denomination.]

In evidence given by Charles Stock, Inspector of W & M in Middlesex, to the Select Committee, on 1.4.1835, he was asked whether he was testing wooden measures by weight of water or measure of water. He replied, "*Measure*". As Stock knew that this method was risking the wooden measures' swelling, we might deduce that he resorted to this method because Middlesex did not have water weights to circumvent that risk.

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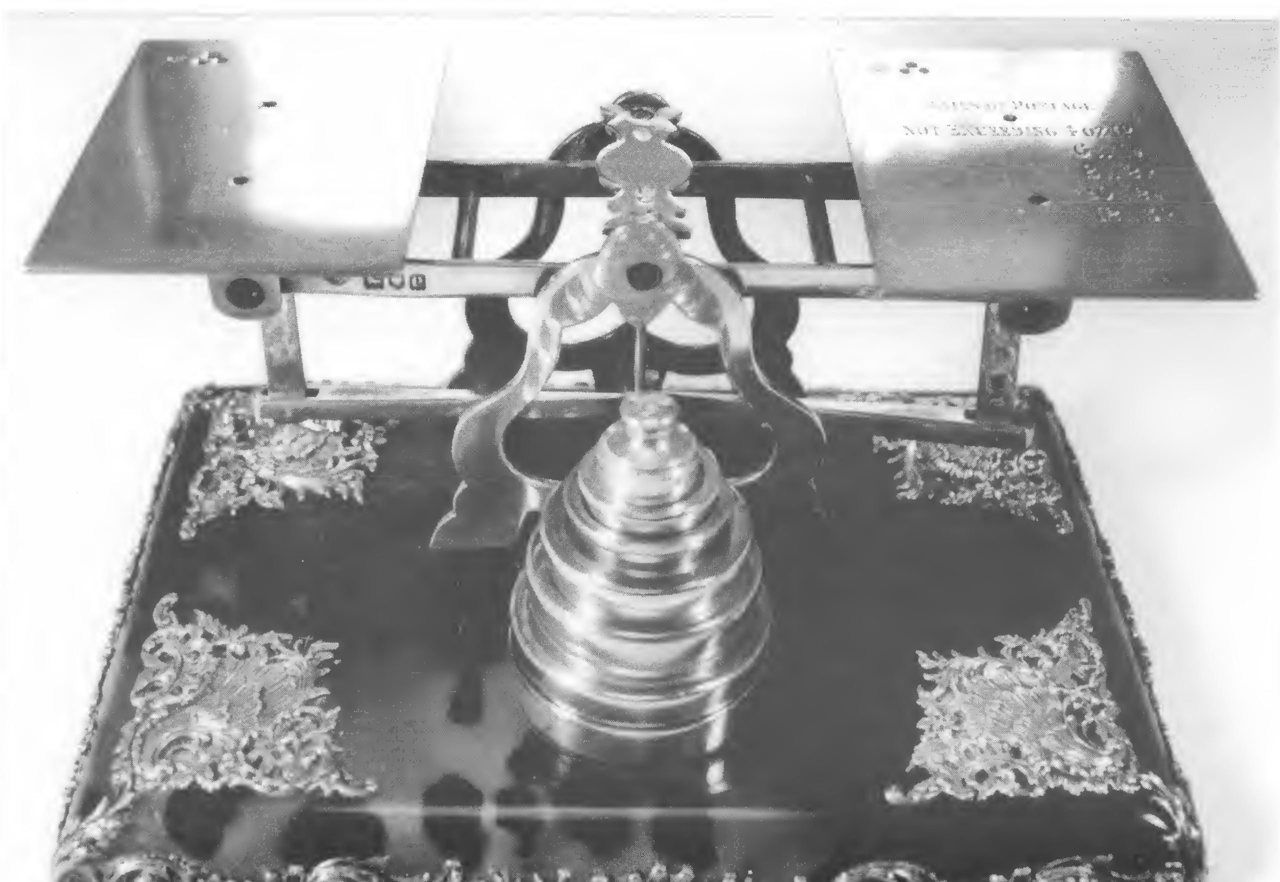

Cover Picture; Showcase

This magnificent letter scale was made by Sampson Mordan & Co in 1920. Being of the most eye-catching design, Mordan provided a pile of tall, pure silver weights of 8, 6, 4, 2, 1 ½ and ½oz, instead of his normal flatter weights. Of course there was no necessity to provide a 6oz weight, as, by addition, all the rates could be covered by 8, 4, 2, 1, ½ and ½oz. But perhaps smart society ladies could not be expected to add up!

Every part of the scale-mechanism was made of solid silver, and the whole scale was sent to Goldsmith's Hall (opposite DeGrave & Co's shop) in Gresham Street, to be assayed and stamped with SM & Co., Sampson Mordan's personal silver mark, the Goldsmith's lion, the leopard's head of London, and the e in a shield, the year mark for 1920-21.

The base is called tortoise-shell, although it is, in reality, from the hawksbill turtle, an endangered species because its translucent shell made such beautiful objects. The shell was prepared by taking a very thin slice or veneer of shell, steaming it to soften it, and moulding it over a form to get the rounded-cornered base shape. (The shell tends to dry out especially if left in sunshine, so the minutest drop of olive-oil may need to be sparingly rubbed over the shell to restore its natural oils and restore its translucence. This is only necessary very occasionally, when the shell looks grey and dull.)

The silver floral scrolls were screwed onto the base, but show no sign of having been hall-marked. Because each decoration was under ½oz in weight it was not required by law to be hall-marked.

From the collection of D AXELROOD

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Thaddeus Fairbanks' Invention, 1830

Part 1 - The Fairbanks' claims

BY A YALE

In St. Johnsbury, Vermont, there are two identical historic roadside markers that claim that Thaddeus Fairbanks invented the platform scale in 1830. Michael Crawforth has successfully refuted this claim by documenting that weighbridges existed in England in the mid-eighteenth century, up to seven decades earlier. While Crawforth's article clearly denies Thaddeus Fairbanks' *world* primacy for the invention of the platform scale, it does not adequately address the issue of when the platform scale was introduced to the United States, or whether Thaddeus Fairbanks independently invented a platform scale without knowledge of its Old World, or even American, antecedents. This article will examine the question of what Thaddeus Fairbanks "invented" in 1830.

The Fairbanks Claims

According to all accounts, the development of the Fairbanks scale was linked to the hemp industry. In 1829, Thaddeus and Erastus Fairbanks and others formed a partnership to establish the Passumpsick Company, which built a hemp-dressing facility on the Moose River in St. Johnsbury. Thaddeus oversaw the construction of the plant, and E & T Fairbanks Company manufactured the hemp-dressing machinery.

In 1880, at the age of eighty-four, Thaddeus Fairbanks wrote down recollections of his early life. The following is an account, in his own words, of the development of the first Fairbanks platform scale:

Having completed three (hemp dressing) machines and put them in operation, it became necessary to have a scale for weighing the straw. For this purpose I constructed a rude platform arrangement, which however, answered the purpose very well -- so much so that my brother conceived the idea of making them for sale as town scales for weighing hay.

I think we built one after this pattern and only one. We had an agent engaged to travel for sales, who was to leave on the stage at three in the morning; and, while sitting up watching to call him, the principle upon which we now build our scales suddenly came to my mind. I remarked to my wife that

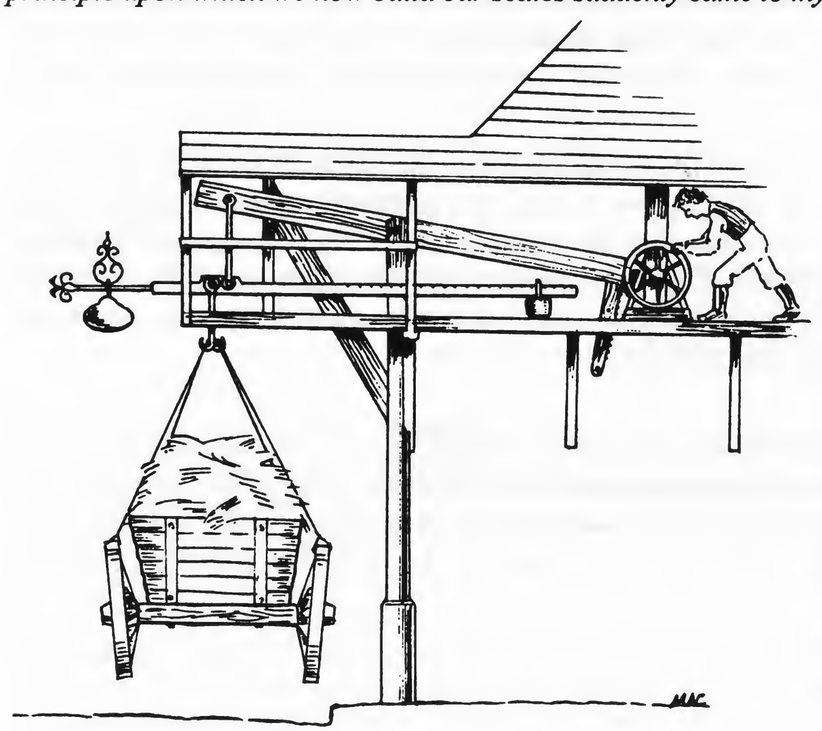


Fig. 1 << Uneven balance for weighing heavy loads.[1] Note that Fairbanks attached the chains to the axles, (not as shown here, attached to the top of wheels that could easily come apart).

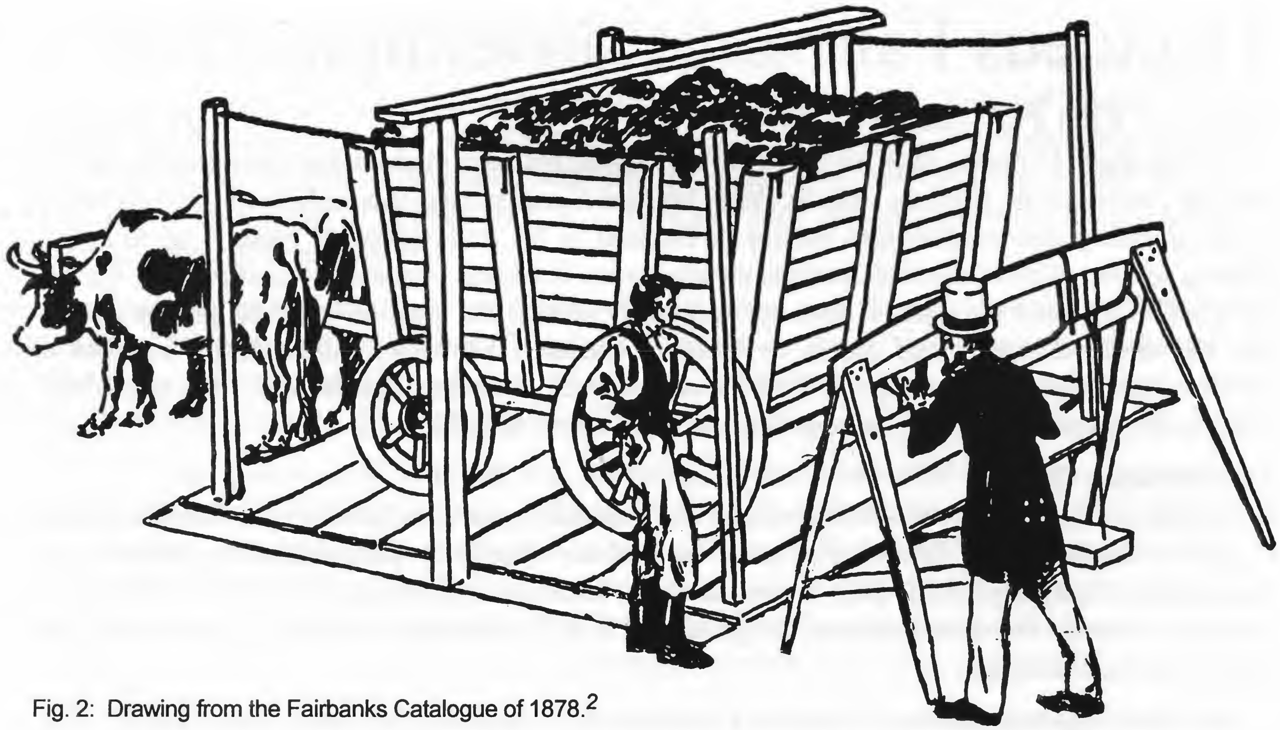


Fig. 2: Drawing from the Fairbanks Catalogue of 1878.[2]

I had just discovered a principle that I wouldn't take a thousand dollars for, as applying to the scale. Our agent was called up and told that he must wait a few days till I could make plans and patterns in accordance with my new discovery. In the course of a few days I had these ready and the agent was started on his work. In a few weeks he had succeeded in selling several scales. The prospects looked well for a good business and more men were employed in building and selling. During the next two years many of the larger towns in New England were supplied with these scales for town use.[3]

According to Edward T Fairbanks' *Town of St. Johnsbury VT,* this was not the first scale at the hemp works. Edward Fairbanks claimed that *a rude apparatus was....contrived by Thaddeus Fairbanks ....by which chains dropping from a steelyard beam suspended on a high frame could grapple the wheel axles, lift the load and get its weight.* This would have been similar to the scale illustrated in Fig. 1 and in EQM, 656.

This account claims that Thaddeus Fairbanks was dissatisfied with the awkwardness and inefficiency of this device and conceived *the idea, wholly novel to him, of a platform resting on levers, which embodied the principles of what is now know as the platform scale.*[4] Unfortunately, Thaddeus' memoirs do not give any technical details of either his original platform scale nor of the improved version. Due to a fire at the patent office in 1835, as well as early changes to Fairbanks patents, the exact configuration of Thaddeus' first scale is difficult to reconstruct.

A Rude Platform Arrangement

There are, however, some hints suggesting the configuration of the original Fairbanks platform scale. Company publicity states: *A platform, balanced upon two bearings in the center of the lever and level with the ground, was held in position by chains attached to posts opposite the four corners.*[5] Company literature also includes an illustration which purports to be of the first Fairbanks platform scale.

This platform, shown in Fig. 2, would have been both unstable and unreliable. It would rock as it was loaded, which might be disconcerting to draft animals. To be reliable, the platform of this scale would have to be in perfect balance, with all four corner-chains slack. Any strain on any corner chain

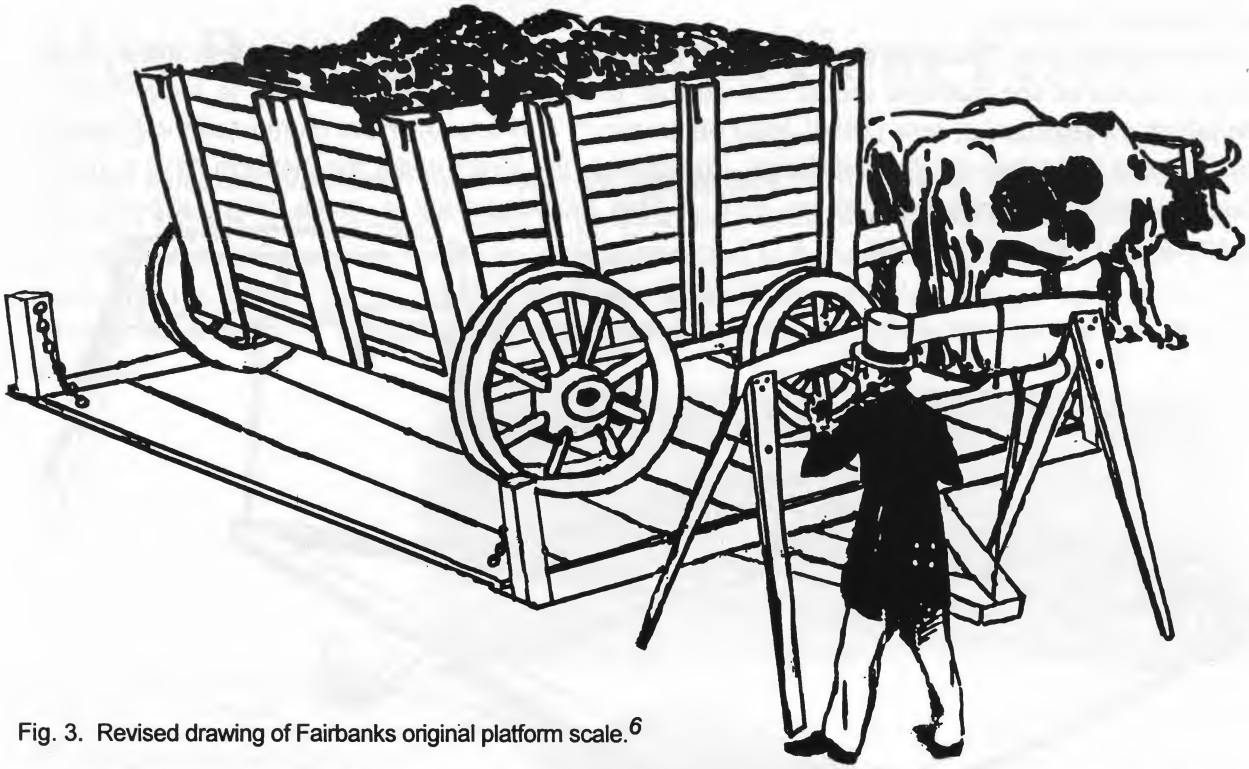


Fig. 3. Revised drawing of Fairbanks original platform scale.[6]

would mean that some of the weight was being transferred to the corner posts instead of being registered by the lever. The mechanical advantage of the lever under the platform would only be about 3:1, which would mean that the weighbeam frame and weighbeam would need to be much sturdier and the weighbeam of much greater real capacity. I suggest that this illustration was made decades after the fact by someone trying to make sense of an earlier written account. Unfortunately, the illustrator probably made several errors in his depiction. The written description mentions that the *platform ....was held in position by chains attached to posts opposite the four corners*. The illustration shows four tall posts on the platform attached to two tall posts beside the platform. In addition, the artist placed the frame for the weighbeam in the way of the wagon's getting on the scale. This would mean that the wagon would have to be backed onto the scale. In light of the fact that the wagon had to be placed so that its weight was evenly distributed on the platform, this mechanism would make it tricky to load the scale.

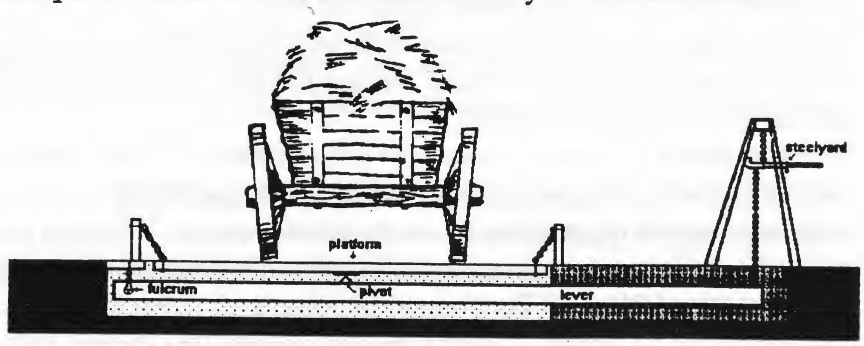


Fig. 4. Schematic drawing of platform balance on two pivots[7]

Figure 3 represents a revised version of Figure 2 that the author feels more accurately conforms to the written description of a platform that was *balanced upon two bearings in the center of the lever and level with the ground, [and] was held in position by chains attached to posts opposite the four corners*.[8] It makes much more sense that the frame and steelyard were located on the side of the platform. Figure 4 is a schematic drawing showing the lever system under the platform.

The improved version

The idea that came to Thaddeus that night (that he recounted in his memoirs) was undoubtedly that the four corners of the platform should rest on four pivots. This design conforms to *the principle upon which we* [Fairbanks] *now* [1880] *build our scales.*[9] This improvement eliminated the inherent instability and inaccuracy of the first design. In addition, the levers under the platform have a much greater mechanical advantage, perhaps 24:1. This would require a much lower capacity of weighbeam and weighbeam frame.

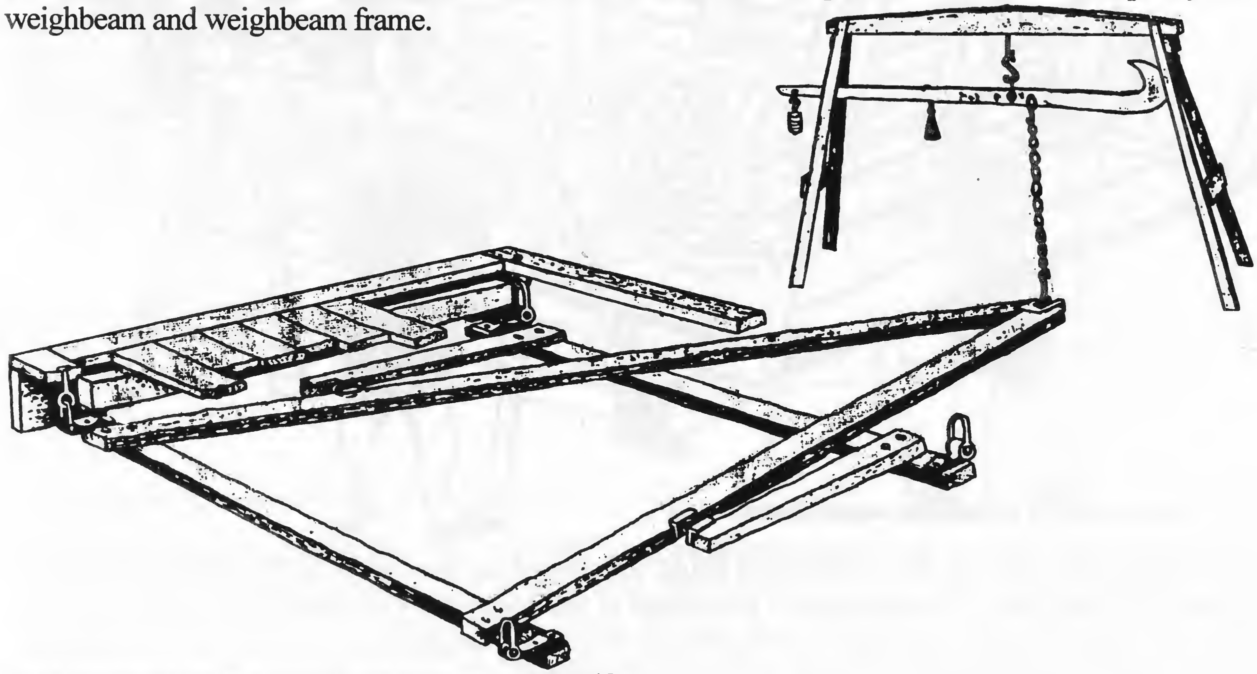


Fig. 5: Early wooden lever compound lever platform scale[10]

As late as 1880 Thaddeus Fairbanks was claiming that, in 1830, he discovered the principle upon which Fairbanks platform scales were based. His nephew, Edward T Fairbanks, perpetuated this version in 1914, as did subsequent company histories.

Part 2 gives a different version of the development of the Fairbanks platform scale by another individual who claims to have been there in 1830.

Notes and References

1 Crawforth, M A, Early Platform Scales, *Equilibrium*, 656.

2 Fairbanks, Morse & Company. *Beginning the Second Century,* Chicago: The Company, 1930, 4, also has this cut.

3 Fairbanks, Thaddeus, *Early Recollections*, February 17, 1880. Typescript made available by Charles Cotter, the great-great-grandson of Thaddeus Fairbanks.

4 Fairbanks, Edward T, *Town of St. Johnsbury VT,* St. Johnsbury, VT: The Cowles Press, 1914.

5 Fairbanks, Morse and Company, *Pioneers in Industry,* Chicago, 1930, 26.

6 Conjectural rendition by author based on revising Illustration 2.

7 Yale, Allen, *Ingenious and Enterprising Mechanics: A Case Study of Industrialization in Rural Vermont* 1815-1900, Ann Arbor: UMI, 1995, 23.

8 Fairbanks, Morse & Company, *Pioneers in Industry,* Chicago: The Company, 1945, 26.

9 Fairbanks, Thaddeus, *Early Recollections*, February 17, 1880.

10 Fairbanks Weighing Division, Colt Industries, *Fairbanks Standard 150 Years 1830-1980,* 1980, 7. Undoubtedly adapted from the illustration in U. S. Patent 123 issued to E. & T. Fairbanks on February 10, 1837.

Author's biography

See EQM p 2191.

Alex Bernstein's Patent Coin Tester

Part 2

BY J LINDNER

From the hand-held coin tester, fig. 6, came the version on a cast-iron stand, fig. 7, which could be fixed to a table or a till, using the holes in its three feet. But unlike the simple rockers, the stand version indicated horizontality by having an indicator fixed to the stand by two screws, and a pointer attached to the beam. By this means, the degree of deviation could be assessed more accurately, although the problem of inaccuracy due to the unequal distribution of the mass of the coin was not addressed.

Fig. 6. One of Alex Bernstein's hand-held counterfeit coin detectors, admired by Brauer as '*very skilfully constructed, which is very much in use, and owing to its simplicity is much in favour.*'[34]

Most of the surviving coin testers by Alex Bernstein are of the type shown in fig. 4 with the inscription BERNSTEIN'S PATENT in one line. Presumably they were produced and sold until the end of 1876, but apparently until this date, Alex Bernstein had not decided to patent his counterfeit coin detector, [CCD].

But after the much more complicated *Apparatus for Sorting Coins*, constructed by his father, Aaron David Bernstein, had 25 patents granted,[17] maybe the thought occurred to Alex to apply for patents for his CCD too. In Germany, this was not possible, because his CCD had been known there for a long time, and was thus not new, but he could apply for a patent in Great Britain.

On 23rd December 1876, Alex Bernstein deposited, using the patent attorney Gerard Wenzeslaus von Nawrocki of Berlin, at the Office of the Commissioners of Patents according to the Law of Patents of that period, the provisional description of his CCD. It received Provisional Protection for six months under no. 4981. During this period protests could be lodged. In England, where similar sovereign rockers had been used for over forty-five years,[3] there were many objections. Presumably therefore Alex Bernstein did not submit his definitive description with a drawing, so his *Scales for Testing*

Fig. 7. Stand version 'BERNSTEIN'S PATENT'. Note that the floral designs are painted onto the cast-iron base in this pointer version.

Coins did not receive the Great Seal of the Commissioners of Patents. After the expiry of his provisional protection the temporary description was published as required under the Patent Laws. See fig. 8.

Only a few days after his British application, Alex applied in Paris, on 3rd January 1877. The French Brevet d'Invention was granted for 15 years on 19th March 1877 under no. 116,314, without officials having checked its uniqueness (*sans garantie du Gouvernement*). The description of the patent was not published and exists only in manuscript. See fig. 9. The texts of both patent descriptions are virtually identical so a translation of the French is not included.[32]

DIEU ET MON DROIT

A.D. 1876, 23rd *December*. N° 4981.

Scales for Testing Coins.

(*This Invention received Provisional Protection only.*)

PROVISIONAL SPECIFICATION left by Gerard Wenzeslaus von Nawrocki at the Office of the Commissioners of Patents on the 23rd December 1876.

Gerard Wenzeslaus von Nawrocki, of the Firm of J. Brandt and G. von Nawrocki, of Berlin, in the German Empire, Engineers and Patent Agents. "Improvements in Scales for Testing Coins by Weight." A communication from Alex. Bernstein, of Berlin, aforesaid.

The object of this Invention is to produce an accurate and convenient means for testing certain coins by weighing, and so that a very slight excess or deficiency in weight will show a great deflection in the scales.

The weigh beam is suspended by knife edges in a staple provided with handle. One arm of the weigh beam is fitted or formed with suitable recesses for the reception of, say, a half sovereign and a sovereign, and these recesses are so arranged in different distances from the knife edges or centre of the scales that a sovereign placed in the furthest recess, or a half sovereign placed in the nearest recess, balance equally well, each distance multiplied by its corresponding coin weight forming the same multiple or product. The other end of the balance beam balances exactly when either coin is put in its place. If the coin is the least too light or too heavy, the balance beam shows an appreciable elevation or depression.

The recesses may be to lay the coins therein flat on their faces, or the recesses may be narrow slots across the balance beam, of the length of the respective diameters of the coins, and of the width equal to the respective thicknesses of the coins.

The scales may, if desired, be attached to a suitable stand.

Fig. 8. Provisional Protection of Great Britain (reduced to 73%).

In both patent descriptions the theory of the English sovereign rocker is described, but, instead of the flat circular recesses on the beam, slots across the beam were offered. Slots with this function were not used in English rockers, where slots in the circular platters served only to test the thickness of the coins.[3] A consequence would be that the unequal distribution of the mass of the coin would almost cease to influence the accuracy of the tests. But up till now, no Alex Bernstein CCD with slots has been found.

It is highly likely that, after the granting of the French patent, that there appeared on the counterpoise of the otherwise unchanged CCDs, a new engraving with an inscription in three lines. (Figs. 6 & 10.)

On the underside is often engraved *PATENT* (see Fig. 11), which must relate only to the French patent, because his CCDs were not patented in any other country. These CCDs can therefore be

116,314

Mémoire Descriptif
déposé à l'appui de la demande d'un
Brevet d'Invention de quinze Ans
formée par Mr **Alex Bernstein**
Pour: "Un pèse monnaie".

Le pèse monnaie représenté dans le dessin si-joint est destiné à essayer toute monnaie ayant cours dans le pays. Dans ce dessin, par exemple, il est disposé de manière à pouvoir peser des pièces de 10 et 20 franks; il est tellement sensible qu'un poids très-minime produit une grande inclinaison du fléau. ——

Dans un étrier a muni d'une poignée b peut se mouvoir un fléau d supporté sur des couteaux c. —

L'un des bras du fléau porte des cavités convenables m, destinées à recevoir les pièces d'argent ou d'or; ces pièces sont placées de telle façon que la distance des centres de ces cavités m à l'axe de rotation c, multipliée par le poids de la monnaie, donne un nombre constant. ——

L'autre côté du plateau d fait osciller la balance, quand on place une pièce d'argent dans la cavité où se fait l'essai. ——

Si la pièce de monnaie est trop légère, ou si elle est trop lourde, le fléau d n'oscillera pas, et, d'après sa position, indiquera un excès ou un manque de poids. ——

Au lieu des cavités m, on pourrait aussi employer des fentes dont les axes sont parallèles, et qui vont en diminuant, leur longueur est égale au diamètre des pièces d'argent - que l'on veut peser de leur largeur est égale à l'épaisseur des mêmes pièces. ——

On peut aussi employer la balance avec un montant solide. ——

En Résumé, je revendique comme nouveau: ——

1° L'emploi de cavités m ou de fentes convenables, destinées à recevoir des pièces de monnaie et pratiquées sur l'un des bras d'un fléau de balance. ——

2° La disposition des cavités ou fentes ci-dessous mentionnées, de telle sorte que l'action de la pièce de monnaie sur l'axe de rotation est toujours constante, dans le but et pour l'objet décrits. ——

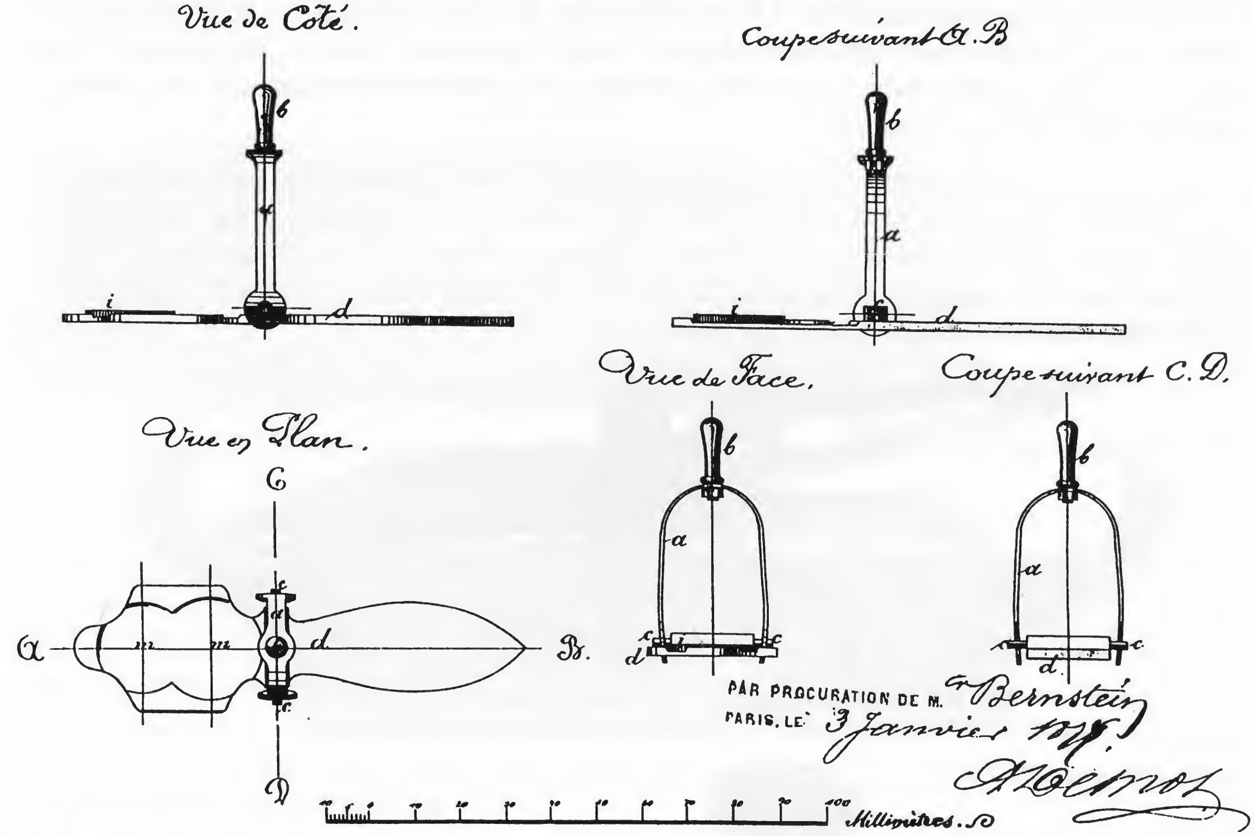


Fig. 9. French Patent no. 116,314, of 3rd Jan. 1877, organised by Bernstein's French representative, M. Desnos, for Bernstein's pèse-monnaie [money weigher]. Bernstein claimed as new the use of cavities **m** to hold the coins and the position of the cavities so that the rotation round the axis would be constant!

dated to the first half of 1877, as the German law of Patent no. 40, effective from 1st July 1877, made it illegal to use any term *which could cause erroneous belief that the objects were protected by the Law* [of Patents].

Later coin testers omit the word *PATENT* on their underside, but nevertheless, the label on the pasteboard boxes say PATENT... (see Fig. 14). Obviously nobody took action, perhaps because it was ambiguously related to the contents of the box! Or perhaps nobody complained!

Fig. 10. ≺≺ 'GOLDWAAGE'. Note the restrained engraving near the fulcrum.

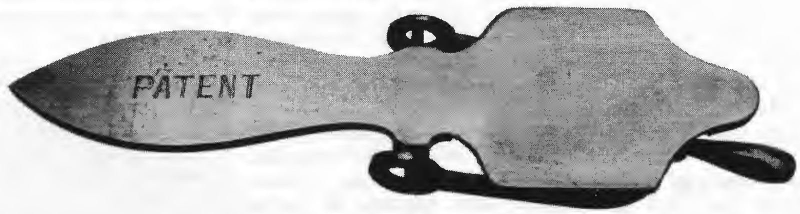


Fig. 11. ≻≻ The underside of the GOLDWAAGE above.

The production period is uncertain for these CCDs made only for coins of ten and twenty Marks. Presumably, after the minting from 22nd April 1877 of gold coins of five Marks, (at first only in the Berlin Mint),[33] the firm made coin testers for all three coins of the German Empire from about the middle of 1877, as large numbers of the 5 Mark piece were already in circulation. Although there is no example known of the hand-held model (figs. 4, 6 & 10) with a recess for the 5 Mark, there is an example of the stand version, the PATENT-TISCH-GOLDWAAGE, (Patent-Table-Goldscale) for the three Reichsgold coins. See figs. 12 and 13.

This version is on a green lacquered, ornamental cast-iron stand with curled upper ends, reminiscent of a Greek galley. These ends serve as fixed points against which the horizontality of the beam can be accurately judged. This provides not only a better judgement of the deviation of the weight of the coin, but also permits a check on the horizontal setting-up of the scale if one is putting the supplied 10 Mark test weight into the middle recess of the beam.

Fig. 12. Patent-Table-Goldscale. Note that the floral decoration is cast into the iron base.

This table version, as well as being known with the counterpoise having the inscription GOLDMÜNZWAAGE-ALEX BERNSTEIN & Co-BERLIN (see Fig. 13), is also known with no inscription on the counterpoise, and with only the ornamental engraving on the beam (as Fig. 17). The latter presumably dates from the time after 1880 when Alex Bernstein had gone to the USA, and the name of the firm had got the addition *Nachf. A Nathan*, (proprietor A Nathan).[9]

This table model was sold in a pasteboard box with a label similar to fig. 14, but with the inscription *Patent-Tisch-Goldwaage*. In the box lay the small label with directions for use:-

Gebrauchs-Anweisung.
Es ist darauf zu achten, dass die Waage auf einer horizontalen Fläche aufgestellt wird.
Man lege die Goldstücke in die für dieselben passenden Ausbohrungen. - Ist das Goldstück vollwichtig, so senkt sich die Seite der Waage, auf welcher das Goldstück sich befindet. Beim Passirgewicht spielt die Waage ein. Ist das Goldstück zu leicht, so senkt sich die dem Goldstück entgegengesetzte Seite der Waage.

Directions for Use.
Take care that the scales are set up on a horizontal plane.
Put the gold pieces in the recesses suitable for each. If the gold piece is full weight, then the side on which the coin is resting will sink. If it is current weight, the scales balance exactly. If the gold piece is too light, the side opposed to the coin will sink.

Fig. 13. Patent-Table-Goldscale and the test weight for the 10 Mark piece.

Last but not least, is an example without an inscription on the counterpoise (figs. 15 to 17) which has the same beam as the previous example. It was in a cap-end case similar to the earlier boxes but with *Patent-Taschen-Goldwaage* (Patent Pocket Goldscale) on the label. Compare figs. 6 and 14.

Fig. 14. << Patent-Pocket-Goldscale. The cap-end case contained the hand-held version shown in figs. 15-17.

This example also had directions for use, safely , at least on this example, stuck to the underside of the box:-

Gebrauchs-Anweisung.
Man halte die Waage an dem Messingknopf und lege das zu wiegende Goldstück in die für dasselbe passende Ausbohrung. Bei vollwichtigen Goldstücken nähert sich die dem Goldstücke entgegengesetzte Seite der Waage der Zeigerplatte. Beim Passirgewicht liegen Beide parallel. Ist das Goldstück jedoch manquirt oder gefälscht, so entfernt sich die Waage von der Zeigerplatte.

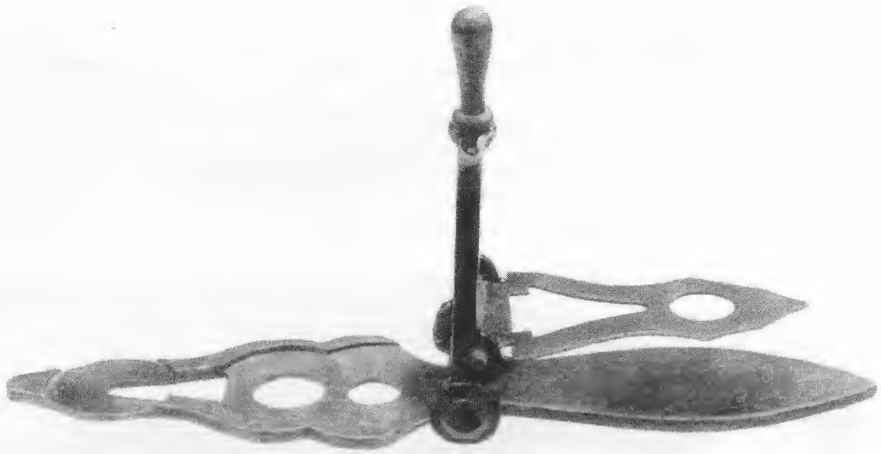
Directions for Use.
One holds the scales by the brass knob and puts the gold piece to be weighed in the suitable recess. If the gold piece is full weight the arm of the scales which is opposite to the gold piece will drop down near the pointer plate. If of current weight, it lies parallel. But if the gold piece is too light or is counterfeit, the beam tips away from the pointer plate.

The peculiarity of this scale, compared with the standard model, consists in the addition of a pointer plate fixed to the shears, which, when holding the tester without putting the hand underneath, stands out horizontally accurately. See fig. 15.

By the parallel position of the beam with the pointer plate, one can recognise very exactly any inaccuracy of the gold piece, even though one cannot measure the discrepancy.

How long CCDs by Alex Bernstein & Co. were produced and sold has not yet been established, because no advertisements could be found in papers or journals, and even contemporary literature only mentions them once.[34] Their chronological sequence could only be inferred from contemporary events, and this may result in new perspectives if advertisements or prospectuses turn up. But because of the variety of these examples, and the variants possibly still to be found, such as one with vertical slots to hold the coins, it must have been an extensive period.

Fig. 15. ⮞⮞ Patent-Pocket-GoldScale with the pointer-plate attached to the shears.



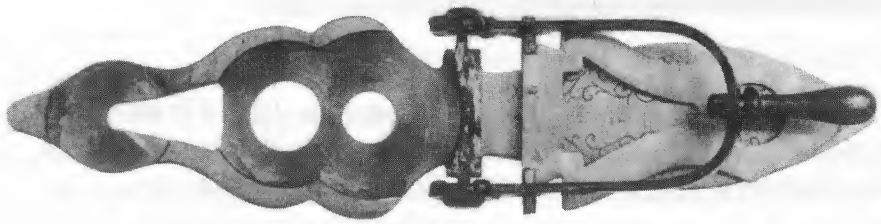
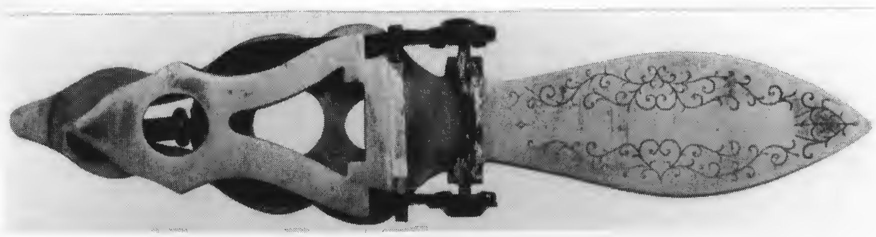


Fig. 16. ⮜⮜ Coin recesses and shears for holding. The extra recess does not overlap the two original recesses.

Fig. 17. ⮞⮞ Pointer-plate and counterpoise (without the maker's name).



Sources & References

3 Crawforth, M A, *Sovereign Balances 1, Standard Rockers*, England, 1983, figs. 62 and 82.

9 *Central-Handelsregister, Deutscher Reichsangeiger no. 40*, 16.2.1880. (Register of Firms, Berlin, no. 13007.)

17 Lindner, J, Aaron David Bernstein's Apparatus for Sorting Coins, *Equilibrium*, pp 1947-55.

32 The translation of the French patent into German can be found in the journal of the German Scale-Collectors' Society, in *Maß und Gewicht*, p 859.

33 *Centralblatt für das Deutsche Reich 1877*, p 236. The first 58,325 gold coins of 5 Mark were minted in Berlin in the week 22nd to 28th April 1877

34 Brauer, E, *Die Konstruktion der Waage*, 1st and 2nd Auflage, Weimar, 1880 and 1887, p 164. 3rd Auflage, Leipzig 1906, Neubearbeitung von Fr. Lawaczeck, p 256. Or see the English translation:

Brauer, E, *The Construction of the Balance*, translated by H C Walters, 1909, p 281-2.

All photographs are by the author.

Author's Biography

Johannes Lindner, native Berliner, was a radio operator then an artillery surveyor during the War, which latter job led to his training and profession as a land-surveyor at the Central Survey Office of Berlin (West) for which initially he surveyed and drew maps. Then he was the leader of the team that did the survey calculations and marked out the new super-highways. He introduced electronic data-processing and for 22 years was responsible for the systems-analysis of all technical calculations at the Survey Office.

For the 14 years of his retirement he has researched weights and scales, photographing and drawing examples, and publishing especially in *Maß & Gewicht*, the journal of the German Scale-collectors' Society. Having witnessed the dispersal and destruction of so many archives and libraries during the War, he is passionately concerned that as much knowledge as possible is retrieved and published. He has published 31 articles, has 6 in the pipe-line and 11 being compiled. A busy retirement!

New York City Scalemakers 1836-1877

Part 1 Gerald & Farr, their friends and competitors

BY S BEARE

A search of New York city and business directories has yielded more information on Gerald and Farr, scalemakers, to supplement the Old Advert 1844, submitted by Jerry Katz in EQM, p 2168, and Allan Yale's follow-up discussion in EQM, p 2191. While the directories sometimes list "Gerald" and other times "Geralds," Yale's information clearly points to "Gerald" as the correct spelling.

Asahel Gerald first appeared in the New York city directories as a scalemaker in 1836, when he was located at Bank, north of West. That same year, there is also a listing at the Bank location for *Chester N Farr, platform scales*, and a separate listing for *Gerald and Farr, platform scales*. They continued to be listed as partners in 1837 at 125 Bank and in 1838 and 1839 at 129 Amos. The 762½ Greenwich address of A Gerald referred to in the letter of February 17, 1840, relating to Gerald/Fairbanks (EQM, p 2191) was Gerald's home address in 1838 and 1839; he moved to 82 Hammond in 1840. By 1841, Gerald had separated from Farr and moved his business a few doors to 133 Amos.

There is also a listing for *Guy C Gerald, scales*, beginning in 1841 at 68 Greenwich Lane. By 1843, both Guy Gerald and Asahel Gerald relocated to the 120 Barrow address of the 1844 advertisement (EQM p 2168), where they remained until 1850. In 1851, they moved to 302 W 13th St, where they remained until Guy's last entry in 1854 and Asahel's last entry in 1855.

After Farr separated from Gerald in 1841, he formed a short-lived partnership, *Farr and Fowler, Scale and Vicemakers*. This business was listed at the 129 Amos address, as was *Albert Fowler, platform scales*, with no further mention of Fowler as a scalemaker before or after 1841. Chester Farr continued to be listed as a scalemaker at a new location of 609 Water from 1843 through 1845, disappeared for four years, and then showed up in 1849 and 1850 at 43 Greene. He moved to 39 Greene in 1851, and on to 126 Amos in 1852. He was listed at 248-252 W 27th in 1854. His final business location, in 1856, was 352 W 27th. In 1857, there was a one-time entry for *Jonathan L Farr, scales*, at the 352 W 27th address.[1]

So from the Old Advert, 1844, mentioning Gerald's Patent Scales, we can reconstruct the presence of numerous scalemakers and their business connections. This information will greatly facilitate further research.

During this directory search, interesting connections with other scalemakers surfaced, and this prompted me to explore the idea of comprehensive scalemakers' directories for the major American cities. The *New York Journeyman's Society* is first listed under "Balances and Scales" at 43 Greene in the 1850 New York City business directory. In 1851, there is a listing for a *New York Journeymen Scalemakers Co* at 39 Greene. (Note that these are the same locations Chester Farr occupied during 1850 and 1851). During 1854 and 1855 , the New York Journeymen Scalemakers Co was located at 221 Pearl and 39 Greene, and in 1856 and 1857 the firm was still occupying the 221 Pearl quarters, but had moved from the Greene address to 41 Wooster. The next entries are found in 1863-65, where the manufactory was located at 73 Laurens, with two other addresses by the last listing in 1877.

A search of business directories showed that *John Bryden and Joseph Robidoux, scales* were listed as partners at the 73 Laurens location during the Civil War years, and a closer look shows they were located at the same address as Chester Farr from 1849 to 1851, and the same address as the New York Journeymen Scalemakers Co from 1850 to 1877, confirming their business connections.

This information helped clarify the origin and approximate 1851-1855 date of a beautiful twin-columned banker's scale on a mahogany base seen at auction last year, signed *Journeymen's Scale Co. 39 Greene St. N. York.* Had I had this information at the time, I would have likely won the lot.

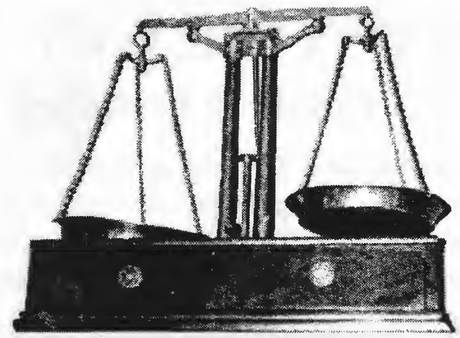


Fig. 1. Journeyman's Scale Co, banker's scale. Computer- image enhanced by N Cima

City directories are a valuable source of information to the historian, but are not widely used by ISASC members searching for the working dates of scalemakers. This is the first in a series of articles to explore how directories can be used to assist in identifying scalemakers, their working dates, and connections with other contemporary scalemakers. Subsequent articles will provide listings, business relationships, and working dates of New York, Philadelphia, and Boston scalemakers of the nineteenth century.

Author's Biography

Steve Beare holds a PhD in chemistry from the University of Illinois and works for the Dupont Company in Wilmington, Delaware. He collects books on 19th century science and technology and collects scientific instruments in addition to scales, especially those by Henry Troemner of Philadelphia.

Notes and References

1 Editor- Such frequent removal from one address to another causes us to contemplate the difficulties that customers had in finding the company when they wanted repeat orders, or repairs.

General Post Office Weights, 1883

These iron ring weights were designed in 1883 to go with the most rugged roberval scales for weighing parcels up to 7lb. See p. 2307. This is one of the rare sets that included an 8lb weight, but no documentary evidence has been found to explain the need for this weight. Note the similarity between the 7lb and the 8lb weight. Mistakes must have occurred because it is only by reading the units (on the reverse of the weights) that one can distinguish between them. The broad arrow was the mark put onto all property belonging to any and every British Government Department.

JIFFY-WAY EGG SCALE

BY R JIBBEN

Until mechanization and confinement of poultry began to impact the production of eggs, many small farmers individually packaged eggs for distribution. An important tool for these small producers was a scale to weigh the eggs to determine the size for marketing.[1]

Benjamin Zimmer of Minneapolis, MN, a machinist, invented an egg weighing or grading scale, and he built a machine to produce it. After filing for a patent on April 8, 1938, he went into production. Patent No. 2,205,917 was issued on June 25, 1940. In time, his Jiffy-Way egg scale was sold widely in the U.S. and abroad. With slight modifications, it is still being made today, using what are believed to be Zimmer's original stamping machines and dies.

As described in the patent, the weighing index includes three categories. The outside sector is graduated from 18-30oz per dozen, the second sector gives the weight of the individual egg from 1½-2½oz, and the colour-coded portion is marked with the commonly-used designations, Extra Large (orange), Large (green), Medium (yellow), and Small (red).

The pointer has a slot so that each egg can be graded by seeing the colour of the label.

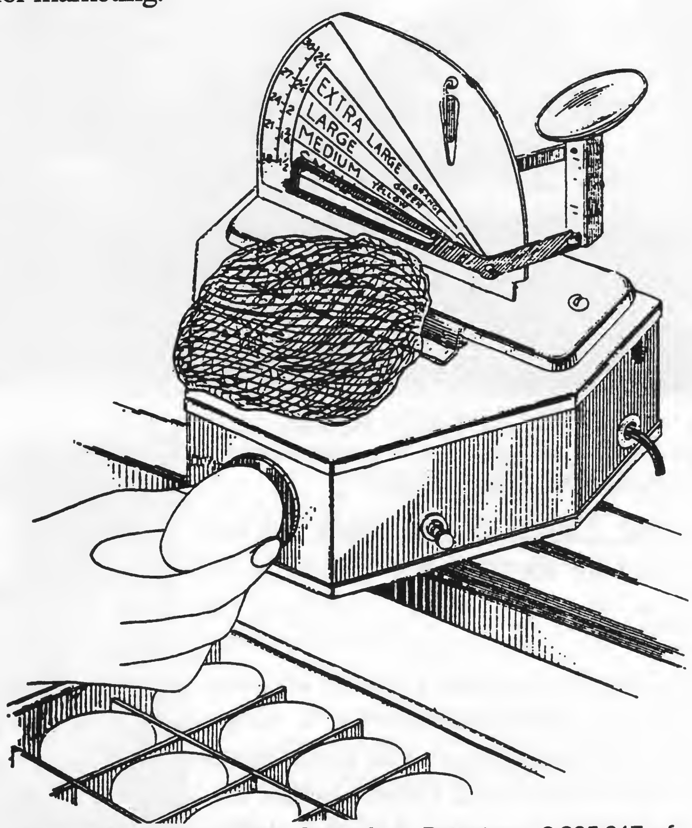
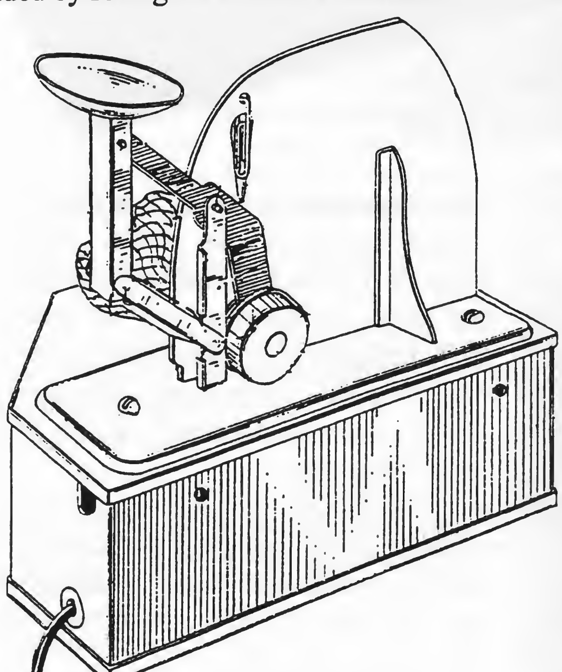


Fig. 1 Front View of Egg Scale from Patent no. 2,205,917 of June 25, 1940. provided by PTCS from PTO APS Image Data Base



A free-swinging paper clip serves as a vertical indicator. The scale patent includes a candler with a casing made of sheet metal, and the patent drawing illustrates a piece of steel-wool for cleaning the eggs. Later a packet of sand-paper was supplied instead.[2]

For ten years, Mr. Zimmer marketed the egg-weighing scale himself.[3] Fig. 3 is thought to date from this period because the lack of a patent number suggests manufacture between 1938 and 1940; its maroon colour is not seen on later models, and the label does not include the Owatonna, Minn., legend that appears on most scales made after 1948.

Fig. 2 << Back View of Scale showing the pendulum mechanism.

provided by PTCS from PTO APS Image Data Base

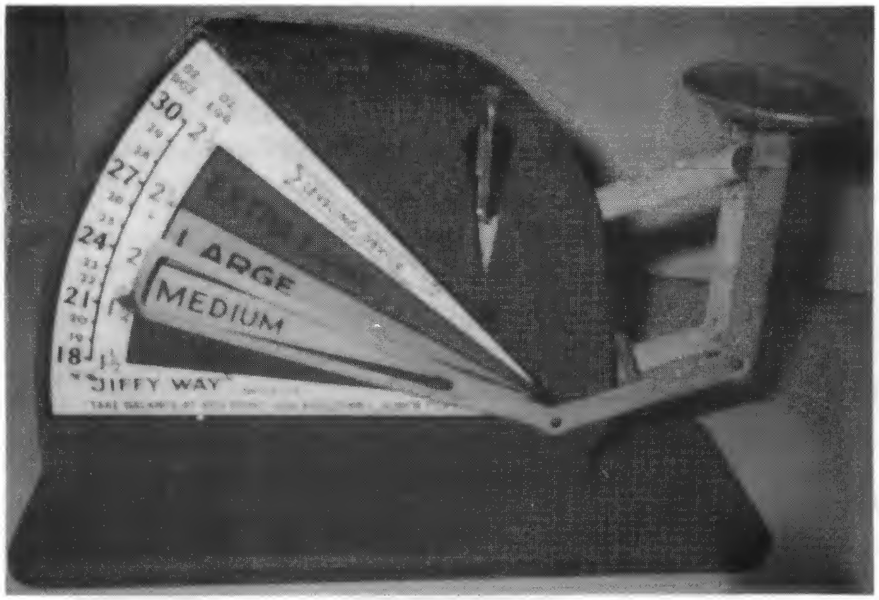


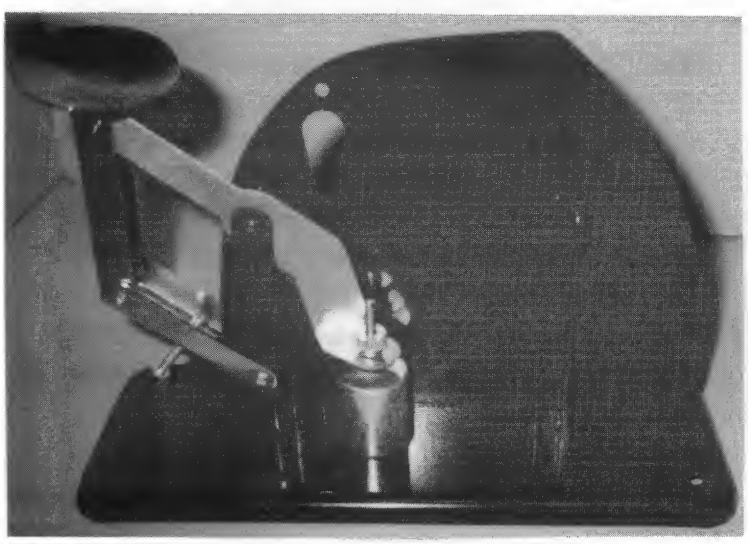
Fig. 3. ≺≺ Early Jiffy-Way Scales with maroon crinkle finish.

Below the graduated arc, it reads 'JIFFY WAY PATENTED. TAKE BALANCE AT RED POINT. USE ADJUSTABLE SCREW FOR SPEED'.

The 'red point' was at the tip of the pointer. The screw was below the vertical leg on the right, and could be set to hit the base at any desired graduation. The result was that the rocking of the beam was minimised but all large eggs above (say) 25oz for one dozen appeared to weigh 25oz if that was where the screw was placed. Photo R Jibben

Fig. 4. ≻≻ The rear view of the early Jiffy-Way showing the paper-clip , the crinkle finish, and the patented design of poise.

In 1948, Zimmer sold his patent and his machine for about $2,500 to C C Jolly Inc, of Owatonna, Minn, a producer of poultry and farm equipment and other hardware. They created a special division called Jiffy-Way Inc to produce it. Clarence H (Connie) Hansen was president of the scale division and Helen Hansen, his wife and the daughter of Carl C Jolly, was vice president. The company also introduced another scale called the Acra-Weigh that weighed and blended feed automatically. Five or six individuals were employed to make the scales.



Jiffy-Way made a few changes in the manufacturing of the scale. They replaced the levelling indicator paper-clip with a split pin, and in about 1953 replaced the sheet-metal, disc-shaped poise containing lead-shot with a cast-iron, threaded, cylindrical poise.[4] See Fig. 5.

Fig. 5. ≺≺ The rear of the modern scale showing the cylindrical poise that has been used since about 1953. The face has JIFFY-WAY T.M. REG. PAT. OFF. INCORPORATED NOW MFG. BY KUHL INCORPORATION FLEMINGTON NEW JERSEY. Photo R Jibben

Poultry Supplies
Cashman Seed Co 114 E Vine..............8292
JIFFY WAY INC
Egg Candlers; Graders & Cleaners
711 N Cedar........................2528
JOLLY C C CO THE
SALES & MANUFACTURE OF
Poultry Equipment
Builders Hardware
711 N Cedar...........2528—2244—6173

Fig. 6 AA C C Jolly Co advert in the 1948 'phone book. The Steele Co. Historical Society

Shortly after acquiring the patent, they changed the candling device to a separate, round cylinder with a hole and light. See Fig. 9. Probably, the scales and candler were sold separately after that time, since most egg scales do not have the candler.

The primary purpose of the candler was to check whether the egg had been fertilised. To determine the fertility of the eggs, the farmer would plug in the light and rotate the egg in front of it, looking for a red spot. The scale gave the opportunity to pick out eggs of a weight most likely to hatch successfully; that was just over 2oz. but under 2½oz. for most breeds.[5]

The candler had a secondary function, checking the freshness of the egg. When an egg is fresh, the yolk is anchored firmly in its centre by two coiled, spring-like membranes called chalazas. As the egg ages, the springs become weak and the yolk drops to the bottom of the egg as it is rotated.

Printing and advertising of the scale was contracted with Photo News, Journal Chronicle and Schroeder Press in Owatonna. The decals were made in Minneapolis. The 22 gauge sheet-metal scale frame was manufactured, painted and assembled at the plant in Owatonna. The scale mechanism was nickel-plated by Superior Plating in Minneapolis. Jiffy-Way scales were packed in cartons of 12, six red and six green, and sold to the distributors for $12.00 per carton in the 1950s. Brief operating instructions were supplied with each scale. See Fig. 7.

INSTRUCTIONS FOR OPERATION OF JIFFY WAY EGG SCALE

Scale is correctly balanced at factory. Do not tamper with scale.

Scale can be balanced at any time by loosening thumb screw on top of weight at rear of scale. Then place 2 oz. weight on egg cup and adjust threaded weight until pointer balances perfectly at 2 oz. Weight will stay in place if thumb screw is tightened and all other check points will also be accurate.

2 oz. balancing weight is not furnished with scale.

JIFFY WAY INC.
Owatonna, Minn.

Fig. 7. AA Instructions for the Jiffy Way.

Jiffy-Way Scales were sold only to distributors. No scales were sold to retailers or individuals. Farm product stores included Our Own Hardware; Coast to Coast; Janney, Semple, Hill & Co; Purina and Farwell Osmund Kirk. Jiffy Way also manufactured scales for Sears, Roebuck and Co. (David Bradley and Farm Master trade-marks); Montgomery Ward; Vala in Chicago; Brower in Illinois; James Way Equipment in Wisconsin; and Kuhl Equipment in New Jersey. Scales have been seen with a variety of decals with different label names, colours (including light green, dark green, maroon and orange), and colour coding (including cream and pink) for egg weights.

EGG GRADING SCALE

The Jiffy-Way Grading Scale of new streamlined design with four-color zone dial. Freedom from use of springs, adjustable screw top, combined with leveling device, gives perfect accuracy balanced to the fineness of a BB shot. Build of 22 gauge steel and finished green or red enamel.
No. 517 $2.10, Wt. each 1½ lbs., Packed 12 in a Ctn., Dept. 2.-

Fig. 8. AA 1955-56 Janney, Semple, Hill & Co. Catalog 1, p 481. A picture was included of a Jiffy-Way with the name MARTIN on the scale.

C C Jolly Co. started in 1943, and the operation closed in 1972. The company had 35-40 employees with annual sales of $1,000,000. Clarence Hansen estimates that over 2,000,000 scales were sold. The building that housed the Jiffy-Way Scale business was standing in Owatonna, Minn, until it burned in 1989.

Fig. 9. ➢➢ 'JIFFY-WAY T.M. REG. PAT. OFF. INCORPORATED. OWATONNA, MINN, WORLD'S LARGEST MFG'S OF EGG SCALES'. mounted on the earlier version of the candler, with steel-wool on the holder. Dark green shiny finish.

Photo R Jibben

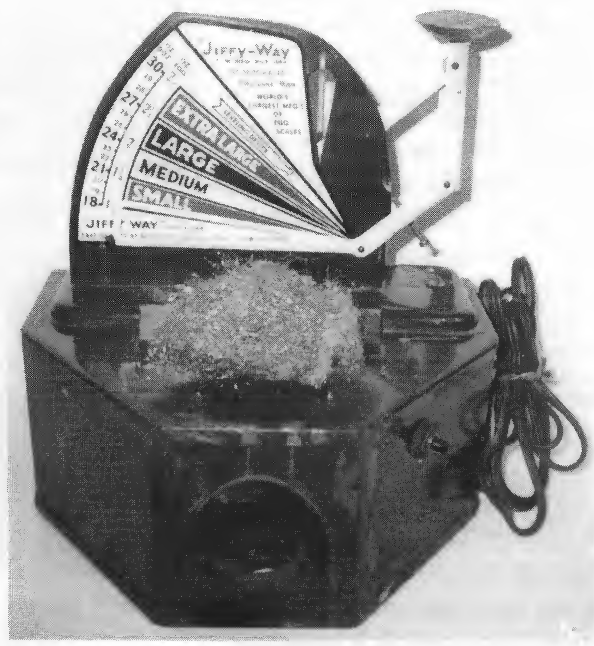


Fig. 10. ⋎⋎ Jiffy-Way made for '**FARM MASTER** SEARS ROEBUCK & COMPANY, OUR PLEDGE OF SUPERIOR QUALITY'.

The separate candler, also made for Farm Master, was intended to be used in the position shown, because, if it was mounted vertically, broken eggs could trickle into the hole and onto the light-bulb.

Photo B Jibben

In 1972 Harry Winters, the firm's accountant, took over the business. He continued to market the Jiffy-Way Egg Scales until 1975. He continued with the same accounts as Jolly Co, but he did not market or advertise the product. During this time about three or four thousand scales were produced and sold for about $5.00 each, giving the retailer a good profit on each.

Harry Winters sold the rights regarding Jiffy-Way Egg Scales to the Kuhl Corp. of New Jersey. Kuhl is still marketing the scale. See Fig. 4. About 600 scales are sold annually. These scales cost $22.50 wholesale and are packaged 12 in a box for domestic distribution but individually for overseas customers. The 1998 catalogue of Murray McMurray Hatchery of Webster City, VA offers the scale to its customers for $35.80 post-paid. The company plans to replace the Jiffy-Way with a new egg scale in the near future.

Notes and References

1 A variety of egg scales have been developed such as those mentioned in EQM pages 375-384, 410-417, 919-924, 1275-1284, and 1311-1317.

2 Can any reader tell us whether Zimmer sold the scales and candlers separately?

3 Minneapolis Directories provide the following clues:-

1937....Residence.... ....Zimmer, Benj. (Leila W) 2442 Bryant Avenue South
....Address Dir. .... no entry

....Classified Businesses.......no entry

1938....Residence.... ....Zimmer, Benj. (Leila W) 2442 Bryant Avenue South
....Address Dir. ....no entry
....Classified Businesses.......no entry

1939....Residence.... ....Zimmer, Benj. (Leila W) 2442 Bryant Avenue South
....Address Dir. ....no entry
....Classified Businesses.... ..no entry

1940....Residence.... ....Zimmer, Benj. (Leila W), 2442 Bryant Avenue South
....Address Dir. ....Jiffy Way Products Inc. egg graders
....Zimmer, Benj. Scale Mfg.
....Classified Businesses.... ...Zimmer, Benj., 11½ West 26th St.

1941....Residence.... .... .Zimmer, Benj. (Leila W), 2442 Bryant Avenue South,
....Pres. Jiffy Way Products Inc.
....Address Dir. ....Under Scales, no information, but 11½ West 26th St. occupied by Hurd
....Electrics
....Classified Businesses.... ...Under scales about 8 companies, but no entry for Zimmer or Jiffy Way.

1942....Residence.... ....Zimmer, Benj. (Leila W), 2442 Bryant Avenue South,
....Mgr. Jiffy Way Products Inc.
....Classified Businesses.... ....Under scales no entry for Zimmer or Jiffy Way. Address not shown.
....Classified Businesses.... ....No entry for Zimmer or Jiffy Way.

1944 ....Residence.... ....Zimmer, Benj. (Leila W), 2020 Girard Avenue South,
....Pres. Jiffy Way Products Inc.

1946....Residence.... .... .Zimmer, Benj. (Leila W), 2100 Girard Avenue South,
....Pres. Jiffy Way Products Inc.

1948....Residence.... .... .Zimmer, Benj., 2100 Girard Avenue South,
....Pres. Jiffy Way Products Inc.

1949....No Directory available.

1950....Benj. Zimmer not mentioned.

Therefore Zimmer must have operated the business from the address at 11½ West 26th St. for only the year 1940. His residence was about 10 blocks from that business. He may have moved the business, or perhaps more likely, contracted the business out to another manufacturer to stamp out the scales and assemble them. Possibly he devoted his time to selling the scales.

4 By examining this poise the collector can date his scale as having been made before or after 1953.

5 Costa, L, Egg Scales, *Equilibrium*, 1275-1284 and 1311-1317, p 1316.

Acknowledgments
The author thanks Clarence Hansen of Owatonna, Minn, Harry Winters of Owatonna, Minn, the Steele County Historical Society and representatives of the Kuhl Corporation for their help in the preparation of this article.

Author's biography
Robert Jibben has devoted his adult life to working with youth in the Minneapolis high schools as a teacher of agriculture, a counsellor, and (until his retirement in 1997) in the alternative public schools programme. He is currently co-ordinating the programmes of the twelve social service agencies that operate a network of alternative private schools in the Minneapolis area. He began collecting scales about six years ago by purchasing several analytical balances that reminded him of his college years. Eager to find some fellow collectors, he went to his local librarian, who showed him ISASC's address in a list of collectors' associations. He next bought some coin scales from Irving Olson and later expanded his collection to include grain and egg scales.

Contemporary Comment, 1929

Moorhouse Ltd. Royal Winchester Works, Padiham, Burnley, 1929.

No housewife need be without a good Scale. Every housewife needs one, especially in these high-priced days, if only to check her purchases - to detect underweight or overweight.

Earliest Computing Scale?

BY A J CRAWFORTH

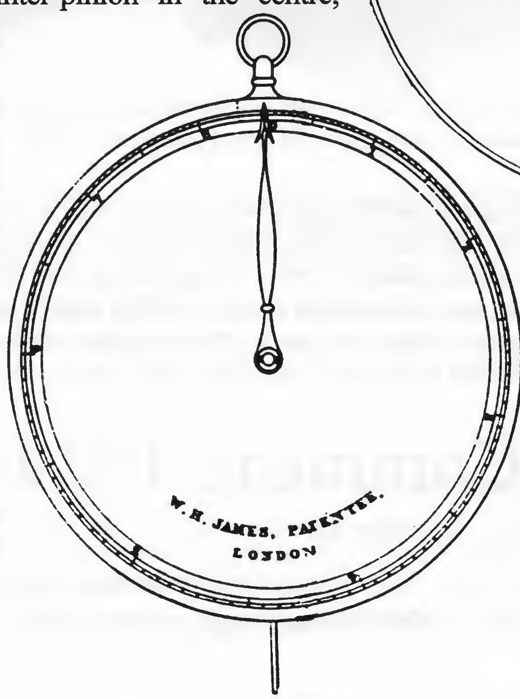
Recently, whilst investigating British patents, a copy of patent no. 7637 of 8th Nov, 1838 was obtained. It was the first British patent to mention pricing[1] and contained many innovative ideas. Patentee William Henry James, civil engineer, envisaged many uses for his inventions.

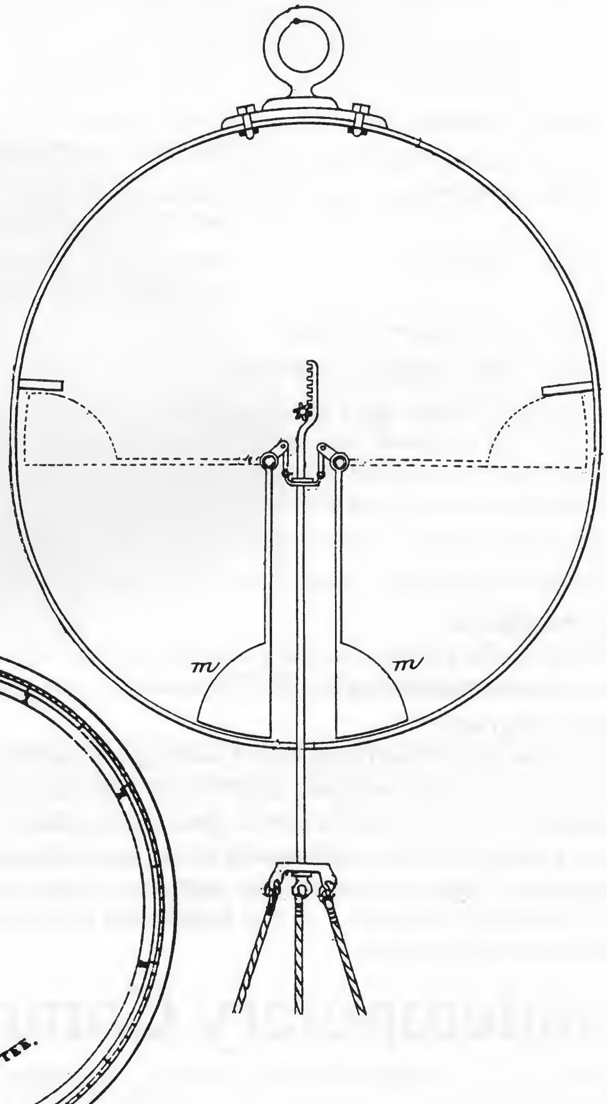
dial-faced double-pendulum scale for indicating weight
dial-face scale with a symmetrical linkage attached to a hanging poise, for indicating value
dial-faced pendulum with cams & straps instead of cranked rods, for indicating weight
a single pendulum scale with part of the bent lever formed by flexure spring, for indicating value
single pendulum scale with the pendulum attached to a lever, for indicating value
equal-arm scale with over and under arc
dial-faced instrument graduated for specific gravity or price
single pendulum scale, for weighing sovereigns in bulk
single pendulum instrument for specific gravity
spring scale with lyre-springs for weight & flexure springs for indicating value
tubular steelyard with price indications on an inner rotating cylinder
dial-face with shutters covering each price

Table 1. W H James Patent of 8th May, 1838, no. 7637.

James described his ideas in great depth; he included 12 pages of explanation plus numerous drawings with his patent. The range of his ideas was so great that one must consider James a major figure in the development of scale technology. Many of his designs appear to be practical and useful. So why haven't any turned up?

Drawings 1 & 2 dealt with a double-pendulum scale that externally looked very like an August Siebe spring balance (patented in 1819). The heavy brass dial, graduated to 8(lb) by 1oz, formed the face of an ovoid case with a pointer-pinion in the centre, rotated by a rack being pulled down by the load. Symmetrical cranked rods were resisted by two poises (*m,m*) which rose as the load increased until they hit stops on the casing.





Figs. 1 & 2. Note the unequal divisions caused by the action of the pendulum.[2]

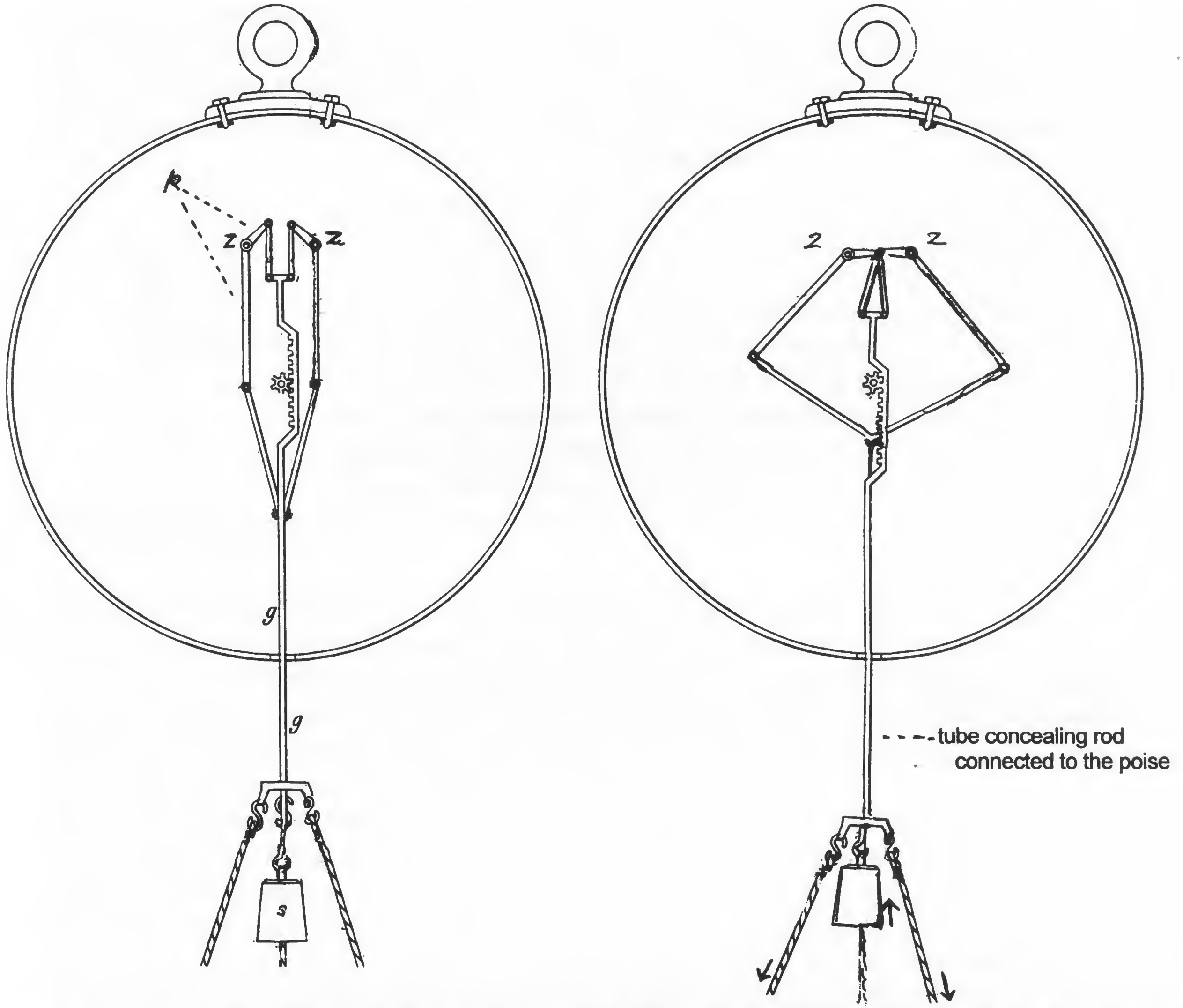


Fig. 3. AA. Left, James' artist's drawing. Another bent lever design, with a very small movement of the load causing the levers (*k*) to pull the poise up. There were problems in moving the linkage while experimenting, because the artist had got the proportions of each leg slightly wrong, and similar problems in doing the drawing on the right, but readers can see the principle adequately. Drawing on left by James' artist and drawing on right by A J Crawforth

James had visualised a simple, practical scale, that wasn't made until 40 years later, as far as is known. He commented in the patent, "*It is evident that a single bent lever, weighted in proportion and connected with a rack, and pinion, and pointer, and dial face, as before described, would answer a similar purpose, though not as perfectly as two bent levers.*"

Fig. 3 is difficult to interpret, but, by making a model, it was possible to make an operational scale. The centre rack was pulled down past the pinion, thus turning the pointer. The top of the rack was attached to symmetrical bent levers (*k,k*), that were pivotted at the points labelled (*z,z*) by the author. When the rack was pulled down, the short arm of the levers came down to the horizontal, and the long arm of the levers swung out, as shown in the sketch on the right. As the bottom of each lever was attached to a rod leading to the poise (*s*), the load's fall was resisted by the poise. James made the rod connected to the poise slide inside the tube connected to the load, so it is not visible in his drawing. James wrote, "*The object of this arrangement being to afford the facility of increasing or diminishing the weight or resistant (s) so as to allow the degrees marked upon the dial plate to correspond in proportion with the aliquot parts of any weight that it may be found advisable to adapt*

the machine to weigh, or to denote the value in money of the aliquot parts of any substance at various prices or rates of value, when such weights are proportioned to a given weight of such substance, the value of which is known or previously determined, and to which the strength and power of the machine has been adapted." James did not indicate whether he added extra little poises for each rate per pound, or attached a new poise according to the rate.

Fig. 4 was essentially the same as Fig. 2, except that cams took a flexible steel strap or chain that attached the poises to the down-pulled rod. By using cams James circumvented the pendulum's problem of creating unequal divisions. He used a phrase that strongly suggests that he made these scales, and in some numbers. "*Although I have described this apparatus as constructed in the drawings* [1 & 2], *I sometimes use segments attached to the upper parts of the levers (k) as shewn at drawing 4, where (g) represents the rod, to which the scale is suspended to the cross-piece, at the extremities of which, instead of connecting the swinging rods (j) I attach steel straps or chains, which pass over and are affixed to the upper portion of the segments at (p) upon which the straps work.*"

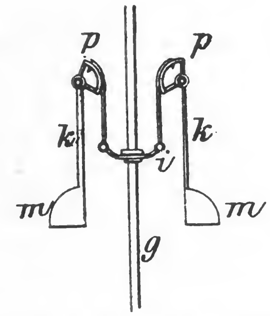


Fig. 4. An early example of using steel ribbons.

Fig. 5 will remind postal scale collectors of the Gabriel Riddle design registration of 1839, (EQM, 1220) for the new Penny Post. But if James' scale had been shown from the side-view, it would become apparent that there was a column at the rear, supporting the graduated arc, and a column at the front concealing the resistant. The crucial clue that James omitted from the text with this design was to explain what the resistant was made of. By deduction, it must have been a flexure spring, attached at its top to the bent lever and passing through the adjustable collar between the pillars. The most flexure was permitted when the collar was at the bottom of the column, so the rate per pound would be marked as the highest at the bottom of the column. Thus, when a load of 1lb was put on the pan, the spring permitted the pointer to swing across the arc to the far side, reading off at the highest price. But when the collar was moved to the top of the column, the spring could only bend with difficulty, and only the very top part of the spring was flexing, so when a load of 1lb was put on the pan, the pointer could only travel across one-twelth of the arc, and would indicate on the arc a price of only one-twelth of that for the previous load.[3]

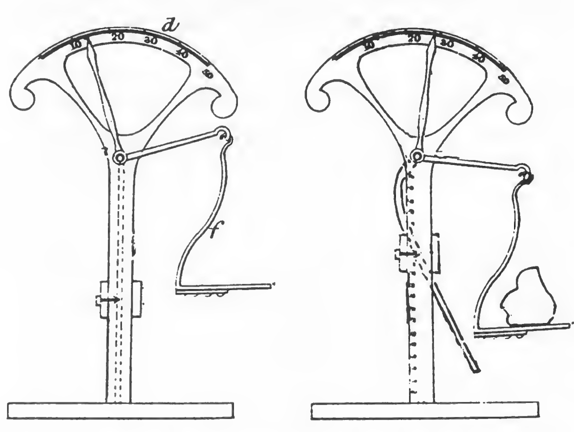


Fig. 5. James' artist's drawing on the left, with the resistant shown inert and straight. He did not draw in the graduations on the front pillar, which started in pennies per pound, with the highest rate at the bottom. The author's drawing on the right, showing the resistant under a load, bending as far as it could when the collar was in that position.

James' comment with Fig. 5 included "*....I will suppose that their weight altogether shall amount to ten pounds avoirdupois, so that each pound weight shall agree with one shilling or twelve pence upon the arc (d) therefore any substance under ten pounds being placed in the scale (f), will have its value in pence indicated upon the arc (d), at the rate of one shilling per pound. I then mark a line upon the upright support (c) opposite the pointer upon the sliding weight (h), which I number one shilling or twelve pence per pound, I then divide the same support (c) into proportioned divisions, so as to shew eleven pence, ten pence, nine pence......one penny , or any other division to correspond with the pounds put into the scale, and the divisions in pence upon the arc above, by which means it will be perceived that any substances placed in the scale, of*

any weight under ten pounds, will have its value denoted in pence upon the arc, to whatever pence per pound the small hand fixed to the sliding weight indicates upon support (c)."

Fig. 6 seems practical, in that the price of a load could be read off the curved arc after moving the poise along the horizontal lever to the mark for the rate needed. The resistant was altered by moving the poise along the lever so that the rate changed. As with the previous scale, there was a column at the rear and another at the front, protecting the rod (*n*). When a load was applied, the short arm of the bent lever moved out to the left, taking the top of rod (*n*) out with it. Rod (*n*) pulled against the horizontal lever, but there would have been a practical problem if this scale had been made. The horizontal lever was a lever of the third order, needing a heavy poise to resist a heavy load.[4] Maybe James thought that the advantage of having a price-indicating scale outweighed the disadvantage of having to move a heavy poise. There appears to be no means of ascertaining the actual weight of the load.

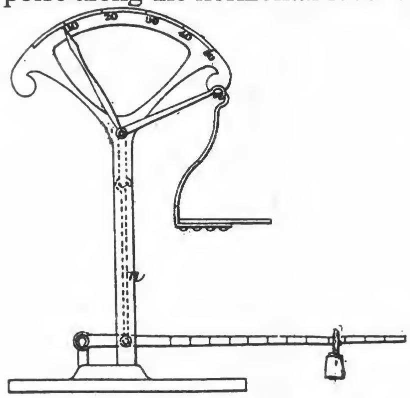


Fig. 6. AA A novel counter scale

Fig. 7 is a principle now used conventionally as an "Over and Under Counter Scale", much used from the 1920s onwards, except that James had a full 16 ounces indicated over or under. The beam, pointer and the short arm under the beam formed a cross. When a load was slightly lighter than the conventional weights in the other pan, the pointer tipped to the left, and the short arm tipped to the right. The bottom of the short arm rose very slightly in an arc, causing the rod in the column to rise with it but resisted by the lever and poise. The column was broad to allow for the sideways movement of the rod.

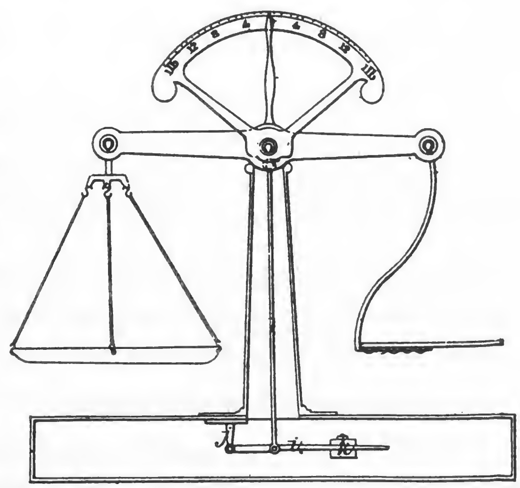


Fig. 7. AA Another lever of the third order, needing a substantial poise to resist a heavy load. Note that the artist has drawn the central knife upside down, suggesting that he didn't understand the principles behind the drawing.[5]

James suggested that fluids could be weighed in the scales, but he did not suggest taring the weight of a container, although the graduated arc could be used in conjunction with the poise on the lever to work as a tare. James did say, "*It is evident that instead of the lever (l) and weight (k)* [poise], *a spring of corresponding strength may be employed in a similar manner, as shewn in drawing 10, which spring, without any inconvenience, might be placed within the stem or tube nearer the centre of the scale beam.*" A spring would provide the resistant, but could not easily be adjusted to tare a container.

Fig. 8 "*represents the interior view of a spring weighing machine (nearly the same as is at present in common use)....by which the scale to contain any substance or the bottle containing the fluid is suspended, ...a series of divisions denoting the specific gravity of any fluid suspended thereto in a bottle of given capacity, between the first division, which is marked 500, and the division marked 2,000, the division which is marked 1,000 indicates the gravity of distilled water at 60° of temperature by Farhenheit's (sic) thermometer, contained in the bottle when filled up to a certain level. ...the aliquot values of any substance may be immediately ascertained.....*"

Fig. 9 needs no explanation, but its suggested function is interesting. "*Suppose the weight* [poise] *attached to the bent lever in the circular box be proportioned so that one hundred pieces of coin, say*

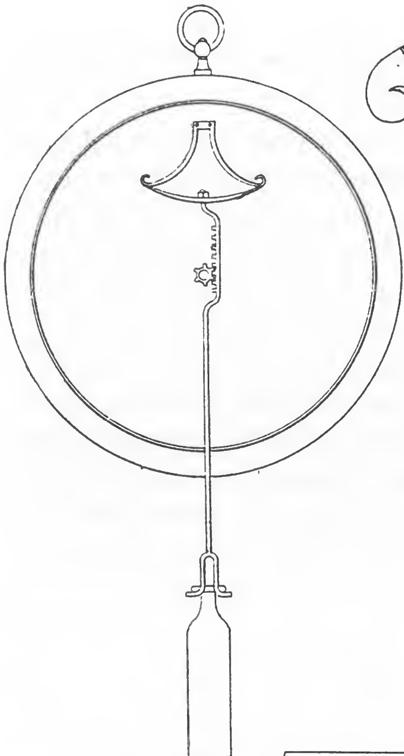


Fig. 8. AA Instrument indicating specific gravity

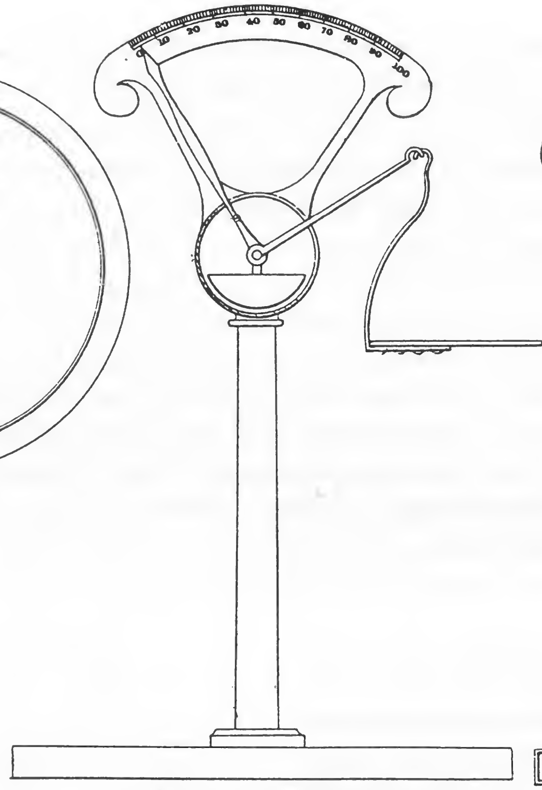


Fig. 9. AA The first instant read-out bullion scale?

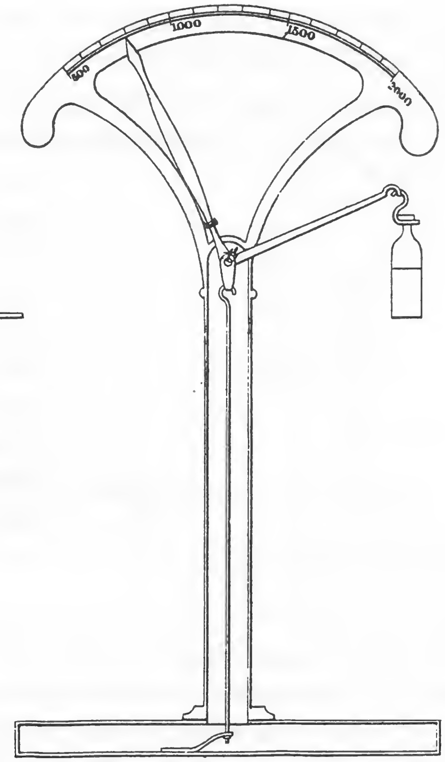


Fig. 10. AA Pendulum instrument with flexure spring resistant.

sovereigns, placed in the scale shall cause the hand or pointer to pass through a certain distance along the surface of the divided arc, say from 0 to 100, as marked thereon, which divisions have been accurately obtained..." So had James invented the first instant read-out bullion scale?

Fig. 10 is another specific gravity instrument, with a flexure spring in the base acting as the resistant.

Figs. 11 and 12 "*represents another machine for denoting both the weight and the value of the aliquot parts of any substance suspended thereto, the price in proportion to a given weight thereof being previously known or determined. This is nothing more than the common dial spring weighing machine inverted, to which I have added the following apparatus for denoting the values in money of the substances weighed by means of another circle of degrees (f) marked upon the dial plate.*" James seems to have tired during his description of this scale, as he used some letters more than once to indicate different items, and omitted letters from the drawing that were mentioned in the text, making an already complicated mechanism even more complicated!

This mechanism consisted of two systems which were activated by the same load but which operated independently. The top system (*a,b,c,d,e*) was a spring balance which indicated the weight. When a load was applied the whole case moved down the rod (*a*). Springs (*c,c*) bent, allowing the rack (*d*) to turn the front pinion of two pinions (which were mounted one behind the other). This front pinion turned the longer pointer using the outer graduated ring.

The lower system was for price indicating only and used a separate rack (*j*) and a second pinion, operating on the same axle as pinion (*e*) but which was therefore out of sight in the drawing.

In order to set the price per pound on the smallest dial, the user turned knobs (*r,r*) until the pointer (*f*) indicated the desired rate. Turning the knobs (*r,r*) did two things; it rotated threaded rod (*o,o*) which firstly lengthened the flexing part of springs (*l,l*) by moving the sliding pieces (*n,n*) outwards, and secondly turned the wheel (*q*) which moved pointer (*f*).

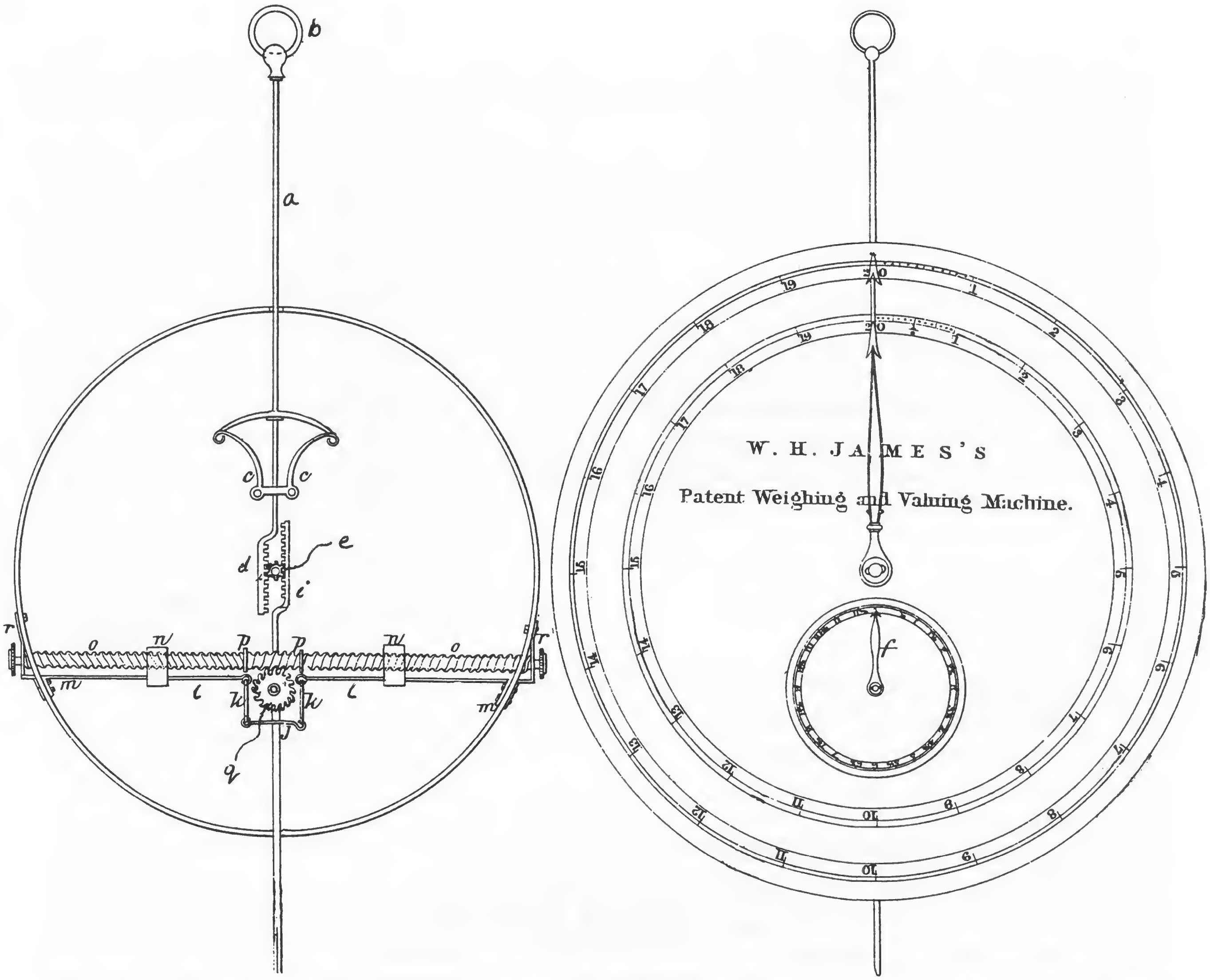


Fig. 11 and 12. AA James' most ambitious new idea, comprising a C-spring balance and an adjustable price-indicating mechanism operated with flexure springs in the same case.

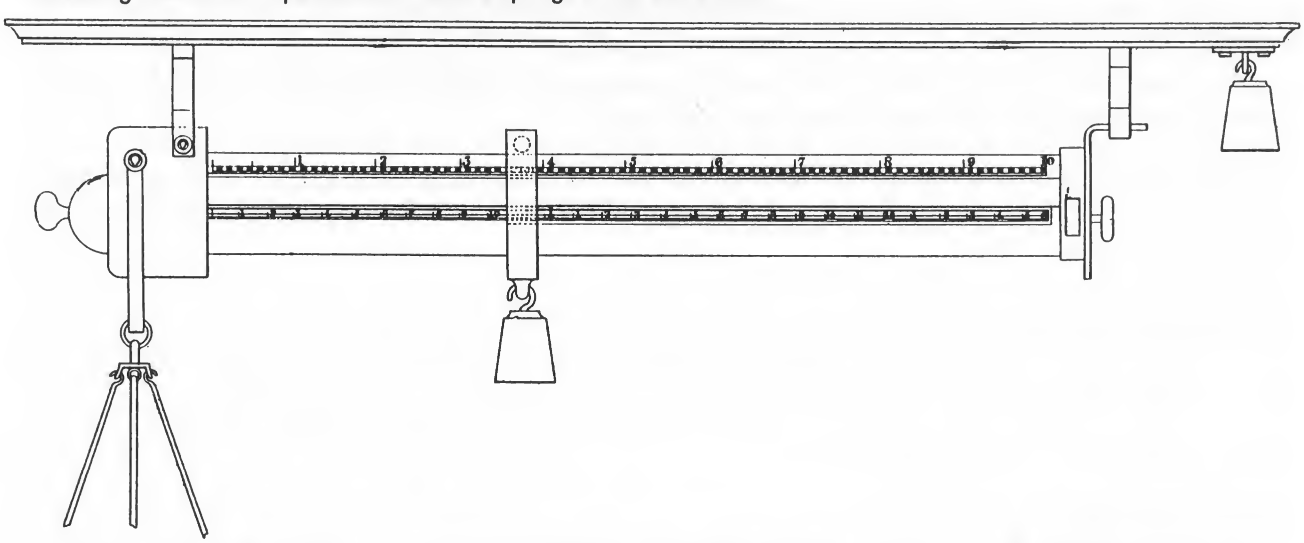


Fig. 13. AA A steelyard with supplementary poises. The inner cylinder revolved, giving instant read-out of the price in the slot. A nose-guard was provided to prevent the steelyard from dropping inadvertently during use. Note that, as in Fig. 7, the artist has shown the knife-edge of the load-pan the wrong way up.

When the load was applied, rod (*i*) descended from the case, pulling down cross-piece (*j*), jointed at the ends to rods (*k,k*) which pulled down the two flexure springs (*l,l*). The other ends of springs (*l,l*) were fixed to the case at points (*m,m*).

James' idea for Fig. 13 was for a steelyard with a hollow tube for its beam, containing an inner cylinder marked with a computed chart of prices per pound, marked in shillings and pennies. The user rotated the cylinder so that the price could be read through the slot (*g*), which went from end to end of the beam. The poise was rolled along the beam, and the price read off on the left side of the hanger of the poise.

James recommended the addition of an extra poise to hang from the rolling poise, *for the purpose of producing an effect equal to the greatest weight or value denoted by the machine, which weight and value is then added to the weight and value found by the sliding piece, when the whole is thereby again brought into a state of equilibrium.*

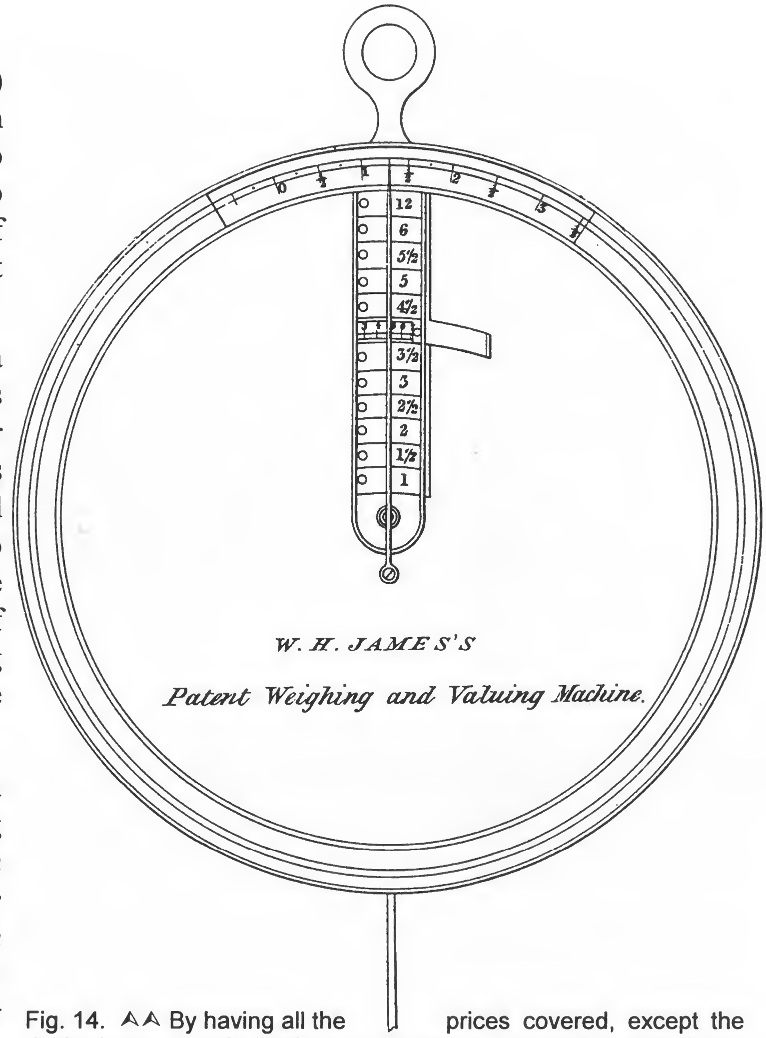


Fig. 14. ^^ By having all the prices covered, except the desired one, no mis-reading could occur. The weight was shown on the outer ring.

This prolific designer's last idea, was for another pendulum scale with a circular plate engraved with concentric lines of prices per pound, to revolve behind the visible dial when the load was applied, Fig. 14. The user ran his eye down the numbers running from the edge to the centre of the visible dial until he found the price per pound, and then slid aside the little shutter at that point. Under the shutter was a window through which the correct price was read..

William James must have had high hopes for his diverse inventions, and yet, apparently none have survived. Are there James' patent scales in existence without their owners appreciating that they were invented as early as 1838?

Notes and References

1 Other articles on pricing scales include EQM pages 2131-2140, 2199-2210, 2227-2230, and 2232-2238.

2 Cheeseman, J, private communication. Thanks to John for his help in preparing this article.

3 If any reader can suggest any other workable alternative, the editor would be pleased to publish it.

4 & 5 Cheeseman, J, private communication.

Author's Biography
Andrew is the younger son of Michael Crawforth, and grew up discussing scales. He believes in handling as many examples of antiques as possible, to learn the maximum, and has used this knowledge to build up his antiques business. He is writing a book on candle snuffers, and has contributed articles to the journal of the Antique Metalware Society, utilising his mechanical understanding and his skill in drawing.

Contemporary Comment, 1883

FROM B STIMPSON

Before the Parcel Post Service, parcels were sent at the same rate as letters, at 2½d. for 6oz, then a ha'penny added for each 2oz up to 12oz, then a penny added per ounce for heavier parcels. This prohibitive cost drove many customers to send parcels by carrier, rail or by friends.

After the Parcel Post started in 1883, a 1lb parcel cost 3d, (instead of 8d) and a 7lb parcel, the largest permitted, cost 1/- (instead of 8/8), so the new service was used very much more than the old service. It was so successful that the service was revised in 1886, with parcels up to 11lb being permitted.

Most scales seem to have been provided to the Post Office by DeGrave, Short & Fanner, (often abbreviated to DeGrave & Co.) but no catalogue of theirs of postal scales is known for the period 1883-1886.[1] This means that evidence is confined to surviving scales, few of which are in collections because parcel scales are bulky objects, with pans up to 11 x 12ins, and weights for 7lb down. Their smaller letter scales supplied to Post Offices, colloquially known as ladder scales, have survived in some numbers, but the pans of ladder scales are only 5 x 5ins, and the top pan has a capacity of 1lb, usually.

So what type of scales were supplied? W & T Avery supplied an *Improved Letter Balance*, of the half-roberval and steelyard type, for parcels up to 4lb (very familiar to Americans, as made by Howe) *specially adapted for Post Offices and Counting Houses, richly japanned and gilt, and can be graduated to any foreign standard*; a more rugged version called a *Lever Balance without Loose Weights with copper scale and brass beam* for parcels up to 7lb (see Fig. 2); a roberval scale on an iron tray or a walnut slab called *Postal Scales for the New Postal and Parcel Service, Letter and Parcel Scales* with the largest weight of 4lb (see Fig. 3); and a rugged counter roberval scale called a *Postal Balance and Weights for the New Postal and Parcel Service, Very*

Circular to Surveyors.

No. 4.
Reg. No. 223,588.

GENERAL POST OFFICE,
6th February, 1883.

SUPPLY OF SCALES AND WEIGHTS TO POSTMASTERS IN CONNEXION WITH THE PARCELS POST.

SIR,

IN order to ascertain what Scales and Weights will be required in connexion with the new Parcels Post Service, will you be good enough to fill up the attached Forms and return them to me *as soon as possible*.

In estimating the probable quantity of Scales and Weights that will be required in your District, it should be borne in mind that the Pan of the Packet Scale hitherto supplied by the Department measures 7½ in. × 7 in., and that each of these Scales is supplied with the following Weights, viz.: 7 lb., 4 lb., 2 lb., 1 lb., 8 oz., 4 oz., 2 oz., and 1 oz., whilst the Pan of the new Parcels Post Scales will measure 11 in. × 12 in., and these Scales will be supplied with the following Weights, viz., 4 lb., 2 lb., and 1 lb.

Seeing that Scales and Weights have never been supplied to any Office without the Surveyor of it stating that such a course is necessary, it is hoped that the information referred to can be readily furnished.

I am,
SIR,
Your obedient Servant,
S. A. BLACKWOOD,
Secretary.

G & S [167] 300 2/83

Superior (Anglo-French) Counter Weighing Machine, to weigh parcels up to 28lb! Fig. 4.

Fig. 2. ^^ W & T Avery Parcel Scale, 1885. Courtesy N Biggs

This last scale looks like a shop scale, but the flat metal pan (as opposed to a flat ceramic pan) and the stamp GPO ought to alert collectors to its being a parcel scale, said by Avery in their 1885 catalogue to be *selected by the Post-Master General as the one most adapted for use in Her Majesty's Postal Service, and of which pattern we have supplied some thousands to the General Post Office*. Square ring weights were sold separately, from 7lb down to 4oz, with the unit of weight cast into one side and the broad arrow and GPO cast into the opposite side. Very occasionally a larger weight for 8lb is found, but it is not known when it was permitted. See p. 2294.

Fig. 3. ^^ W & T Avery Parcel Scale, 1885 Courtesy N Biggs

The Day & Millward catalogue of 1889 showed accelerating roberval postal scales with a square pan only 8 x 9ins for the 7lb size, and only 10 x 11ins for the 14lb size. *This machine can be made to Vibrate*. Were these used by the General Post Office? Would the GPO want accelerating beams? Day & Millward did not specifically say that they were for the GPO, so possibly they were for use in the offices of big companies. Many companies produced parcel scales for office use.[2]

Fig. 4. ^^ W & T Avery Parcel Scale, 1885 Courtesy N Biggs

By 1911 DeGrave & Co were supplying the Post Office with vibrating counter roberval scales *for years past we have exclusively manufactured many thousands for HM Post Offices at home and abroad*; platform scales, either with a short pillar and steelyard to be used on a counter, or with a taller pillar and a dial face, to be used on the floor.

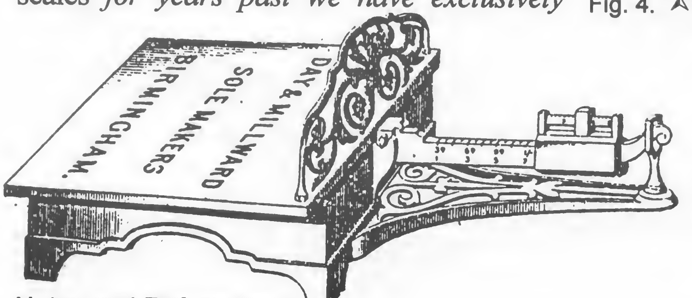


Fig. 5. << Day & Millward New Pattern Weighing Machines for Parcel Post. 1889.

Notes and References

1 If a member owns such a catalogue, copies of it would be much appreciated.

2 A good selection of parcel scales for private use is shown in EQM, p 1256-1258.